LIFE HISTORY CHARACTERISTICS OF FRESHWATER FISHES OCCURRING IN MANITOBA, SASKATCHEWAN, AND ALBERTA, WITH MAJOR EMPHASIS ON LAKE HABITAT REQUIREMENTS

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Life History Characteristics of Freshwater Fishes Occurring in Manitoba, Saskatchewan, and Alberta, With Major Emphasis on Lake Habitat Requirements

by

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Abstract

An extensive literature review was performed to compile information on habitat use among various life stages of freshwater and anadromous fishes occurring throughout Alberta, Saskatchewan, and Manitoba. The major emphasis was placed on the use of lake habitats by various species for some portion of their life cycle. Preferences for the primary habitat features of depth, substrate, and cover were rated as nil, low, medium, or high. Habitat preference tables were assembled for 75 of 97 species. In addition, text synopses were prepared for each species outlining habitat preference information and life history characteristics. These synopses were also used to highlight seasonal and ecosystem differences in habitat use exhibited by various species.

Résumé

Nous avons mené une vaste revue de littérature pour compiler l'information sur l'utilisation de l'habitat parmi les différents stades biologiques des poissons dulcicoles et anadromes présents en Alberta, en Saskatchewan et au Manitoba. L'aspect principalement examiné était l'utilisation de l'habitat lacustre par diverses espèces pendant une portion de leur cycle. Les préférences visant les caractéristiques principales de l'habitat que sont la profondeur, le substrat et le couvert ont été classées en quatre catégories : nulle, faible, moyenne et forte. Des tables des préférences ont été établies pour 75 espèces sur 97. De plus, pour chaque espèce, un résumé narratif indique les préférences en matière d'habitat et les caractéristiques biologiques. Ces résumés ont aussi servi à mettre en relief les différences saisonnières et écosystémiques dans l'utilisation de l'habitat chez les diverses espèces.

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Introduction

Information on the diversity and complexity of habitat use by various life stages of fish is necessary for the effective management of fish and their habitat. Most fish species utilize a range of habitats throughout their life history and exhibit characteristic shifts in relation to life stage as well as seasonal and daily requirements (e.g., spawning, rearing, overwintering, summer refugee, and diel feeding activity). Species may also exhibit regional or ecosystem-related differences in habitat use. As outlined in recently published and related manuscripts, this knowledge is important when assessing potential impacts on fish and fish habitat resulting from development activities (Lane *et al.* 1996a,b,c; Bradbury *et al.* 1999).

As an approach to assessing fish habitat, and the potential for loss of productivity in relation to development activity, the Department of Fisheries and Oceans (DFO) has an on-going project, called 'Defensible Methods of Assessing Fish Habitat'. The assessment process is quantitative and involves the integration of two numerical valuation systems. The first system delimits the area affected by a development project and provides pre- and post- breakdowns of the area characterising fish habitat according to depth, substrate, and cover. The second system consists of a series of modules which relate habitat characteristics to fish species by life stage or production processes, producing habitat suitability values using the Habitat Suitability Matrix method. The linkage between the two systems involves a specification of fish community and productivity objectives as a basis for weighting physical and fish factors. When quantification is complete, the assessment process produces a site-specific measure of the net gain or loss of fish habitat productivity as required by DFO policy under the *Fisheries Act*.

This document presents a summary of physical lake habitat requirements, or Habitat Suitability Matrices, for freshwater fish species occurring throughout Alberta, Saskatchewan, and Manitoba as well as anadromous species occurring in coastal areas of Manitoba. For each species, all life stages known to inhabit, or potentially inhabit lakes or reservoirs, were investigated. Where possible emphasis was placed on regionally derived information and habitat-use accounts to ensure the regional relevance of the Habitat Suitability Matrices. However, for many species, specific Prairie Provinces habitat use literature is not available and the summaries are based on studies from other geographic regions. This represents an important limitation in the summaries that were compiled. In addition, it is also possible that other sources of grey literature or unpublished data exist for some of these species, and were not available for the preparation of this report. Other limitations of this report include: 1) sampling bias in the literature that the habitat suitabilities are based on (i.e., more intensive sample effort in some habitat types); and, 2) variability in habitat use based on habitat features not captured by the parameters of depth, substrate, and cover (i.e., temperature preference, predator-prey interactions, and species assemblage in various waterbodies).

Methods

This report is a literature-based compilation of habitat requirements by life stage for all freshwater fish species occurring in lakes in Manitoba, Saskatchewan, and Alberta. The literature base was drawn from the complete geographic range of each species, but was reviewed for applicability to the lake conditions found in the Prairie Provinces. The emphasis of the report is on the utilisation of lake habitats by species when one or more life stages occur in lakes.

The life stages identified for the Habitat Suitability Matrices include: i) spawning; ii) young-of-the-year (YOY) rearing; iii) juvenile; and, iv) adult. Habitat requirements were reported on the basis of three physical habitat features: i) depth; ii) substrate, including pelagic (i.e., open-water areas, not directly influenced by the shore or bottom); and, iii) cover and structure.

The water depth ranges evaluated were: 0 to 1 m; 1 to 2 m; 2 to 5 m; 5 to 10 m; and, >10 m. Substrates were divided into: bedrock; boulder; rubble; cobble; gravel; sand; silt-clay; muck (detritus); hard-pan clay; and, pelagic. Structure/Cover associations were assessed for: none, submergent vegetation, emergent vegetation, overhead (e.g., riparian), in-situ (e.g., woody debris), and other (specified and documented by species and life stage as required). More detail regarding these habitat classifications is available in Bradbury *et al.* (1999).

Both published and unpublished literature was used to compile the lake habitat requirement information. In addition, unpublished data and personal communications with independent experts were used to supplement the available literature.

The strength of the associations between habitat and life stage, for each of the physical features assessed, was reported in tabular form using a rating system as follows:

- High, species is nearly always associated;
- Medium, species is frequently associated;
- Low, species is infrequently associated; and,
- Nil, species is not associated.

Where there was no available information to determine if a habitat association occurred, the rating for that feature was left blank (Tables 2 to 76). All references cited in the synopses and individual species tables are listed at the end of the document. The common and scientific names of all species discussed in this report are summarised in Table 1.

Results

A total of 105 species are reported to occur in the freshwaters of Alberta, Saskatchewan, and/or Manitoba (Table 1). Of these, 21 are introduced (or exotic), or were introduced at one time and may or may not presently occur. One hybrid, splake (lake trout x brook trout), is also reported to occur. Seventy-six of the 105 total species are relatively abundant and have information available indicating that they utilize lake habitat in the Prairie region for some portion of their life history. Summaries and ranking tables were prepared for these 76 species (Tables 2 to 77). The remaining 22 species are listed in Table 78 with comments indicating the reason for their exclusion.

Lamprey (Petromyzontidae)

Silver lamprey (*Ichthyomyzon unicuspis*)

Silver lampreys are found in scattered locations in the Red and Winnipeg rivers in Lake Winnipeg and in the lakes and rivers in the Nelson and Hayes River systems in Manitoba (Scott and Crossman 1998; Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). They may also enter at least the lower Whitemouth River, based on two records of adults found on angled walleyes in and just below Whitemouth Falls. This species does not use smaller streams inhabited by brook lampreys and is intolerant of salt water (Scott and Crossman 1998).

This species of lamprey ascends rivers to spawn in May and June and constructs shallow nests in gravel riffles out of stones, sweeping away sand and silt. After spawning all adult lampreys die (Scott and Crossman 1998). The eggs hatch within a week and the ammocoetes burrow into the mud and silt margins of the river for a four- to seven-year period. Metamorphosis begins in the late fall of their final year as ammocoetes and they are completely transformed by spring. They then move downstream into a lake and begin their parasitic life stage on fish. The only time the lamprey is not pelagic during this phase is in the summer when they inhabit areas of lakes at depths up to 2 m. The remainder of the time they are associated with depths of between 2 and >10 m (Scott and Crossman 1998). Their parasitic stage lasts for approximately twelve to twenty months (Scott and Crossman 1998) following which the now sexually mature adult lamprey migrate to rivers to spawn.

Sturgeon (Acipenseridae)

Lake sturgeon (*Acipenser fulvescens*)

Lake sturgeon occur in Alberta only in the upper reaches of the North and South Saskatchewan rivers (Nelson and Paetz 1992; Scott and Crossman 1998), and in the Red Deer, Oldman, and Bow rivers (Berry 1996). In Saskatchewan they occur in the North and South Saskatchewan and Churchill River systems and associated channels (Wallace 1991) while in Manitoba they occur in the Churchill-Nelson drainage basin (Lake Winnipeg, Assiniboine and Red rivers, Lake Manitoba and Lake Winnipegosis) (Scott and Crossman 1998). There are limited data on whether sturgeon populations travel between Saskatchewan and Manitoba, but migrations can cover long distances (Wallace 1991). Hydro developments in the river systems they inhabit have limited their ability to migrate between provinces or any great distance. In the South Saskatchewan River in Alberta, two sub-populations are known to migrate 70 km between up river summer, and down river winter habitats (Wallace 1991).

Generally lake sturgeon inhabit the shallow, warm-water, bottom areas of lakes and large rivers (Nelson and Paetz 1992). Sturgeon are substrate feeders and have a high affinity for silt, clay, and detrital substrates, and are found less frequently over gravel and sand (Lane *et al.* 1996c; Scott and Crossman 1998). Sturgeon are found at depths between 2 m and <10 m year-round (Lane *et al.* 1996c; Scott and Crossman 1998) with velocities <80 cm/second in rivers (Haugen 1969). In the fall and winter sturgeon adults are reported as inhabiting depths between 1 and 5 m in lakes (Lane *et al.* 1996c).

The females are reported to spawn only once every five years (Wallace 1991) at the age of 20 to 25 years. Spawning occurs in the spring and early summer, specifically in May and June in the South Saskatchewan River (Berry 1996). Lake sturgeon are known as primarily large river spawners, preferring coarse substrate in flowing waters at depths of 1 to 5 m (Berry 1996; Scott and Crossman 1998). Spawning areas reported by Lane *et al.* (1996a) include shallow areas in or below rapids, with boulder, cobble, rubble, gravel, sand, or hard-pan clay substrates with in-situ cover. Spawning in lakes is also reported for this species; however, in the Prairie Provinces this has only been observed in Manitoba along the eastern shores of Lake Winnipeg (Keith Kristofferson pers. comm. 2001, Manitoba Conservation ph. [204] 345-1450). Lake spawning in Saskatchewan and Alberta lakes has not been observed. The water temperatures can vary between 10 and 21°C during the spawning period (Berry 1996) but optimal temperatures are reported as 13 to 18°C (Scott and Crossman 1998).

According to topographical gradients of the Saskatchewan River, Saskatchewan, potential spawning sites are the Torch, Mossy, and Missipuskiow rivers (Wallace 1991). The eggs are shed, fertilized, and then scattered in the river current where they adhere to the rock substrate (Berry 1996). The eggs incubate among rocks or gravel for eight days or hatch when temperatures reach 16 to 18°C (Scott and Crossman 1998). The fry then hide beneath rocks until they move into quiet backwater habitats (Wallace 1991). YOY have an occasional affinity for lake habitat at depths of 2 to 10 m where the substrate is frequently sand and silt/clay. Occasionally YOY are found over rubble and gravel, and infrequently found in submergent and emergent vegetative cover (Lane *et al.* 1996b). Juveniles have a high affinity for lake habitat (Scott and Crossman 1998) at depths between 1 and 10 m in the fall, and between 1 and 5 m in the winter (Lane *et al.* 1996c; Scott and Crossman 1998). Their preferred substrates are frequently gravel, silt, and muck (Scott and Crossman 1998) and infrequently sand (Lane *et al.* 1996c).

Mooneye (Hiodontidae)

Goldeye (*Hiodon alosoides*)

Goldeye occur throughout the major lakes in central Manitoba and in the Nelson, Churchill, Red River, and Assiniboine drainages. In Saskatchewan this species is found in the North and South Saskatchewan River system (Atton and Merkowsky 1983; Scott and Crossman 1998). Goldeye are found throughout the Peace, Hay, Athabasca (including Lake Athabasca, Claire Lake, and other shallow lakes in the Peace-Athabasca Delta), North Saskatchewan, South Saskatchewan, Bow, and Red Deer River drainages in Alberta (Nelson and Paetz 1992; Scott and Crossman 1998).

Goldeye occur in large rivers with high turbidity, and also small lakes, ponds, and marshes connected to them (Kennedy and Sprules 1967). The muddy shallows of larger lakes are also ideal habitat. They spend winter in deep areas of lakes and rivers and move to shallow, firm-bottomed substrate of spawning areas in the spring (Scott and Crossman 1998).

Most females in this region become mature at an age of approximately 6 years of age (Nelson and Paetz 1992). Goldeye are spring spawners, and in the Peace-Athabasca Delta spawning occurs in the last half of May when the ice breaks up and continues for three to six weeks in the Prairie River (Kooyman 1972). In this population, the eggs hatch in early June (Nelson and Paetz 1992). However, spawning times vary in Canada between May and June and are dependent on temperature (Kennedy and Sprules 1967). Ideal water temperatures for spawning are reported as between 10.0 and 12.8°C (Scott and Crossman 1998). The spawning habitat for this species is generally reported as muddy, turbid rivers (Brown 1971) or in backwater lakes and ponds of rivers (Scott and Crossman 1998). The eggs are semi-buoyant so that incubation is completed in the water column. Once hatching occurs larval fish will float at the water surface

(Scott and Crossman 1998). The turbidity of spawning areas has limited the ability to study spawning activity and specific habitat associations for this species (Kennedy and Sprules 1967).

In July and August in the Peace Athabasca Delta the YOY have been found frequently in a 1.5 km periphery of Lake Claire, off Spruce Point near the mouth of Birch River, and in the large bay south of Prairie River in Mamawi Lake (Kooyman 1972). Juvenile and adult goldeye may utilize separate habitats (Scott and Crossman 1998). In some locations, adults are known to continue upstream migrations from the spawning sites to larger lakes and rivers in late July, likely to feeding areas. They then complete a downstream migration in the fall that is generally concluded by October (Kooyman 1972).

Mooneye (*Hiodon tergisus*)

Mooneye occupy waters throughout central and southern Alberta, Saskatchewan, and Manitoba (Nelson and Paetz 1992; Scott and Crossman 1998). This species can be found in the North and South Saskatchewan River drainage basins in Alberta (Nelson and Paetz 1992) as well as the Saskatchewan River system and headwaters of the Assiniboine River in Saskatchewan. It also occupies lakes and rivers in the southern half of Manitoba (e.g., Lake Winnipeg, Lake Winnipegosis, Lake Manitoba, and the Assiniboine and Red rivers) (Scott and Crossman 1998).

Mooneye are often found with goldeyes, but they seem to prefer somewhat clearer water and lower current than the goldeye (at least in Manitoba) (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Mooneye feed mostly in swift waters, but are found in non-flowing, low silt, shallow water, generally between 2 and 10 m and rarely below 12 m (Lane *et al.* 1996c; Scott and Crossman 1998). Adults and young are found associated primarily with sand and silt substrates (Lane *et al.* 1996b,c). Maturity is reached by 3 years of age for the males and 5 for the females. Spawning occurs in the spring (Nelson and Paetz 1992) in April/May, and mooneye migrate to rivers to spawn (Scott and Crossman 1998).

Mudminnows (Umbridae)

Central mudminnow (*Umbra limi*)

Central mudminnow is reported to occur in a tributary to the Saskatchewan River along the Saskatchewan-Manitoba border and south-eastwards into southern Manitoba. It is most common and widely distributed from the Red River eastwards (Fedoruk 1971; Atton and Merkowsky 1983; Scott and Crossman 1998). Mudminnows spawn in the spring from mid- to late April at a water temperature of 13°C (Scott and Crossman 1998). In some areas within their geographic distribution the adults have been reported to move from the lake depths into shallower water to spawn (Scott and Crossman 1998). However, most mudminnows in eastern Manitoba live in boggy habitats in the headwaters of the Red and Winnipeg rivers and Lake Winnipeg tributaries and don't have access to deep lake habitats (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). They do show lateral movements into shallower water to spawn in Manitoba.

Nests are not prepared for the eggs but they are laid in areas with dense vegetation (Scott and Crossman 1998). The eggs adhere to the vegetation during incubation. After six days the young hatch and flooded benches provide protection for the newly hatched young as they move back to the main stream channel (Scott and Crossman 1998). The females mature at age 1 and males at age 2 years. The summer habitat is usually heavily vegetated ponds or pools of small creeks, where the bottom has a thick layer of organic material (Scott and Crossman 1998). Mudminnows are known to take in atmospheric oxygen when dissolved levels are low (Scott and Crossman 1998) and are tolerant of hypoxia. They may spend the winters not far from where they are found in the open-water season (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Carps and minnows (Cyprinidae)

Common carp (*Cyprinus carpio*)

Common carp are a non-native species found in southern Saskatchewan in the Qu'Appelle and Missouri drainage basins (Atton and Merkowsky 1983), and in the Assiniboine and Red River systems in Manitoba. Manitoba occurrences include Lake Winnipeg, Winnipegosis, and Manitoba, the Nelson River drainage, and Dauphin, Playgreen, Cedar, and Split lakes (Scott and Crossman 1998). Split Lake is the location of the most northern record of carp in North America. They are also probably the most abundant large fish species in the Red River and in the adjacent wetlands of the south basins of Lakes Winnipeg, Manitoba and Dauphin (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Carp is an omnivorous feeder and vegetation and detritus make up the bulk of its diet (Scott and Crossman 1998). Studies in the Qu'Appelle system of Saskatchewan have shown that common carp can be found in silty areas with emergent vegetation as well as sand and rock substrates with no vegetation (Saskatchewan Environment and Resource Management [SERM] - unpublished data 2001).

Spawning usually takes place from May to July in weedy or grassy shallows where there is little or no current (Scott and Crossman 1998). The warming of the water to 17°C triggers the spawning adults and spawning continues until temperatures reach approximately 28°C, ending the spawning activity (Scott and Crossman 1998). Eggs are extruded and adhere to any available substrates such as submerged weeds, grasses, roots, debris, and stones (Brown 1971). They hatch in approximately three to six days depending on water temperature (Scott and Crossman 1998) and the YOY live in the same habitat as the adults. Common carp mature at an average age of 4 years (Scott and Crossman 1998).

Lake chub (*Couesius plumbeus*)

Lake chub are commonly found in lakes, rivers, and small creeks throughout Alberta, Saskatchewan, and Manitoba (Scott and Crossman 1998). In Alberta, they are widespread in the

Hay, Slave, Peace, Athabasca, Beaver, North and South Saskatchewan, Battle, Red Deer, Oldman, Bow, and Milk River drainages (Nelson and Paetz 1992).

This species is frequently found in lakes and streams with both clear and very muddy water (McPhail and Lindsey 1970) and are found in a wide variety of habitats, independent of substrate type (Brown 1969). Lake chub mature at the age of 3 years, then spawn from June to mid-August (Nelson and Paetz 1992). When the water temperatures reach 4°C the lake chub migrate from lakes into streams to spawn. Spawning begins when temperatures reach approximately 8°C (Golder 1998a). This species is also known to spawn in lakes. The main areas chosen for spawning are reported as shallow rocky shoals and shorelines (Golder 1998a). However, lake chub will also use vegetation along shorelines when rocky substrate is not present (Golder 1998a). No nests are built and the eggs are fertilized over substrates including silt, detritus, gravel, rubble, cobble, or boulder (Bradbury *et al.* 1999). In Lac La Ronge, Saskatchewan, the lake chub were observed spawning amongst and underneath large rocks in the shallows of the Montreal River in late May until July (McPhail and Lindsey 1970). River spawning populations are known to spawn approximately one month prior to lake spawning populations (Golder 1998a).

The non-adhesive eggs hatch in ten days at 13°C and fry emerge in early June. No parental care is given (Brown 1971). The fry move about freely in the first few centimetres of water of the river mouths or streams for approximately one month. The fry then congregate at mid-depth, in low current water (Golder 1998a). In the late summer months fry have been found in deep water in lakes amid emergent vegetation (Brown 1969). Juveniles are found in a wide variety of habitats within lakes at various times of the year. In July and August large schools of juveniles were reported to be associated with exposed rocky shoal areas with moderate vegetation (Brown 1969). In the summer months, adults can be found along the shallow-water of lake shores and in deeper water by late September. Large numbers of adult lake chub have been found in Lac La Ronge, Saskatchewan at depths of 4 to 6 m over rocky substrate (Brown 1969).

Brassy minnow (*Hybognathus hankinsoni*)

Brassy minnows are found in the Milk River drainage, Musreau Lake (part of the Smoky River drainage), and in the Athabasca River around Fort McMurray in north-eastern Alberta (Nelson and Paetz 1992). This species is found from the Cypress Hills region (Missouri River drainage basin) to the Qu'Appelle, Souris, and Whites rivers and headwaters of the Assiniboine River in southeastern Saskatchewan. In Manitoba, brassy minnows occur only in the Assiniboine, Dauphin Lake, and Red River drainages (Scott and Crossman 1998). This minnow prefers clear slow streams with sandy bottoms in cool waters (Brown 1971). In northwestern regions, brassy minnows occur in slow streams, boggy lakes, and shallow bays. The complexly coiled gut of the brassy minnow suggests that it is adapted to feed on plant material. It is known to feed on algae, which it scrapes from the bottom (Brown 1971) and on plankton and aquatic insects (Scott and Crossman 1998). Reports from the Pembina River, where brassy minnows are abundant, indicate they have mostly filamentous algae and detritus in their guts (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Spawning occurs in the minnows second or third year during May to July (Brown 1971) and eggs are deposited in quiet water over a silt bottom, vegetation, or debris when temperatures reach 10.0 to 12.8°C (Scott and Crossman 1998). However, spawning habits are not well documented. Lane *et al.* (1996a) reported lake occurrence as low for this species and indicated habitat preferences of gravel, sand, and silt substrates, in waters <2 m deep, as well as some association with submergent vegetation.

Silver chub (*Macrhybopsis storeriana*)

Silver chub is limited to Red River system and the Assiniboine River upstream to the Treesbank Ferry in Spruce woods Provincial Park. They have also been observed in the South Basin of Lake Winnipeg (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). This species inhabits large sandy or silty rivers and lakes (Scott and Crossman 1998) however very little has been published concerning the habitat use of this species in Manitoba. In the Great Lakes region they are known to utilize both lake and stream habitat. They spawn in the spring on gravel or sand substrates; the adults also inhabit a wide range of depths, prefer gravel, sand, and silt-clay substrates, and have some association with submergent or emergent vegetation (Carlander 1969; Lane *et al.* 1996a,c; Scott and Crossman 1998).

Pearl dace (*Margariscus margarita*)

Pearl dace are commonly found in cool ponds, creeks, and lakes from the foothills of Alberta, through Saskatchewan, and across Manitoba (Atton and Merkowsky 1983; Nelson and Paetz 1992; Scott and Crossman 1998). In Manitoba, they are one of a species association that is characteristic of bog habitats in headwaters of streams in Eastern Manitoba. This species association also includes the central mudminnow, the northern redbelly dace and the finescale dace (and hybrids between the last two) (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). The brook stickleback, fathead minnow and apparently dwarfed headwater populations of the white sucker also form part of this complex, but are also found in other quiet, vegetated habitats (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Spawning is reported to occur in the spring at depths of <1 m over substrates of gravel, sand, silt, clay, detritus, and hard-pan clay (McPhail and Lindsey 1970; Lane *et al.* 1996a; Bradbury *et al.* 1999). YOY utilize area of <5 m deep with substrates of silt, clay, and detritus. Juveniles and adults utilize similar substrates but tend to occur at greater depths, generally from 1 to 10 m and tend to move off shore, to deeper, cooler waters if temperatures rise above 20°C (McPhail and Lindsey 1970; Bradbury *et al.* 1999). Lane *et al.* (1996c) indicated depth preferences for all life stages of this species to be <2 m in the Great Lakes region. All life stages tend to associate somewhat with submergent and emergent vegetation (McPhail and Lindsey 1970; Lane *et al.* 1996a,b,c; Bradbury *et al.* 1999). Spawning has been reported to occur in tributary streams or in vegetated areas along the periphery of lakes in early spring over substrates ranging from sand and gravel to soft, organic materials (Bradbury *et al.* 1999).

Golden shiner (*Notemigonus crysoleucas*)

Golden shiner occur in the Souris River in southeastern Saskatchewan (Scott and Crossman 1998) and in the Missouri drainage (Nelson and Paetz 1992). In Manitoba, this species is found in the Assiniboine and Red rivers, and Lake Winnipeg. It is abundant in Assiniboine River oxbow lakes in Spruce Woods Provincial Park, where it is part of a distinctive oxbow lake species association. This association includes the golden shiner, blacknose shiner and black chin shiner. Mudminnow and the two *Phoxinus* species also occur there, but less commonly (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). There are also reports of this species being collected in Lake Manitoba, the Whiteshell Forest Reserve, and from a tributary of Lake Winnipegosis (Scott and Crossman 1998).

The habitat of this species is reported as clear but sluggish waters of streams, ponds, and lakes where there is an abundance of aquatic vegetation (Brown 1971). Aquatic vegetation is utilized for cover, spawning substrate, and as a food source (Brown 1971). Golden shiner mature at the age of 2 years in the colder part of its range, and spawning occurs from May to August. The adhesive eggs are deposited over aquatic vegetation where they develop without parental care (Brown 1971).

Emerald shiner (*Notropis atherinoides*)

Emerald shiner are found in all the major rivers in Alberta and Saskatchewan, including the Athabasca, Peace, Beaver, North and South Saskatchewan, Bow, Red Deer, Oldman, Petitot, Milk, Churchill, and Qu'Appelle rivers (Atton and Merkowsky 1983; Nelson and Paetz 1992). Emerald shiner are also found in Lake Athabasca, Bistcho Lake, and Lesser Slave Lake in Alberta (Nelson and Paetz 1992). In Manitoba, this species is found in Lakes Winnipeg, Winnipegosis, and Manitoba as well as the Assiniboine and Red rivers (Scott and Crossman 1998).

Emerald shiner occur primarily in large rivers and lakes (Scott and Crossman 1998). They are found in the pelagic zone and are generally found near the surface in summer months but move inshore in autumn, particularly the YOY. While inshore in autumn, the YOY tend to aggregate at docks, piers, and river mouths and then migrate to deeper water for overwintering. In early spring they move into surface waters at night, and deep waters during the day (Scott and Crossman 1998). YOY may be found in association with both emergent and submergent vegetation (Lane *et al.* 1996b). Adult emerald shiners have been reported to avoid habitat with aquatic vegetation (Brown 1971; Lane *et al.* 1996c) although they have been observed in areas of emergent vegetation (SERM - unpublished data 2001).

Sexual maturity is reached in its second year. Emerald shiner are reported to spawn in the months of June to August, at temperatures around 24°C (Scott and Crossman 1998), and near the surface over either shallow or deep water (Brown 1971). Spawning also occurs over a wide range of substrate types (Lane *et al.* 1996a).

Common shiner (*Luxilus cornutus*)

Common shiner are found in most tributaries of the Red and Assiniboine rivers in Southern Manitoba, and less commonly in the mainstems. They are also found in some of the western tributaries of Lake Dauphin and Swan Lake in Manitoba (Scott and Crossman 1998). In Saskatchewan, this species is limited to the southeastern portion of the province in the Souris River and lower reaches of the Qu'Appelle drainage (Atton and Merkowsky 1983).

Common shiner spawn inshore in the spring (May) when water temperatures reach 15.6 to 18.3°C, on gravel in flowing water. They excavate shallow nests in the gravel or use nests made by other fish (Scott and Crossman 1998). The eggs are adhesive after they become water hardened. The common shiner is principally a stream species, but they often occur in the shoreline habitat of clear-water lakes in waters <2 m deep (Scott and Crossman 1998). They are often associated with aquatic vegetation and with sand and gravel substrates (Lane *et al.* 1996c). They usually feed at the surface but occasionally will take food off the bottom and will consume plant tissues (Scott and Crossman 1998).

Blacknose shiner (*Notropis heterolepis*)

Blacknose shiner are found in many lakes and streams in southern Manitoba, including Lakes Winnipeg, Winnipegosis, Manitoba, and Dauphin (Scott and Crossman 1998; Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). It occurs northward into the Nelson and Hayes rivers. In the Assiniboine drainage, it is found in oxbow lakes in Spruce Woods Provincial Park. It is not found in the Red River or its tributaries (Dr.

Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). In Saskatchewan, this species is found as far north as Waskesui Lake and is reported to occur in the Whitesand and Qu'Appelle rivers in the south-eastern part of the province (Atton and Merkowsky 1983). Little information is available related to the habitat use of this species. Scott and Crossman (1998) and Lane *et al.* (1996c) indicate the use of depths <2 m, gravel and sand substrates, and some association with emergent and submergent vegetation.

Blackchin Shiner *(Notropis heterodon)*

Blackchin shiner are found only in Manitoba in the prairie region and have been observed in Lake Dauphin, several Assiniboine drainage oxbow lakes, and the Souris River drainage (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Little information is available related to the habitat use of this species. They are reported as common in Lake Dauphin, and have been observed in macrophyte beds along the shores (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Scott and Crossman (1998) and Lane *et al.* (1996a,b,c) indicate the use of depths <2 m for all life stages. Spawning is reported as associated with gravel, sand, and silt-clay substrates and with submergent and emergent vegetation. Juveniles and adults are also associated with gravel, sand, and silt-clay substrates and with submergent and emergent vegetation (Lane *et al.* 1996c; Scott and Crossman 1998).

Spottail shiner (*Notropis hudsonius*)

Spottail shiner are found in lakes and streams throughout Alberta, Saskatchewan, and Manitoba (Atton and Merkowsky 1983; Nelson and Paetz 1992; Scott and Crossman 1998). The only areas where this species is not found are in the headwaters of the Smoky, Athabasca, Red Deer, and Bow rivers in eastern Alberta, the Missouri River drainage basin in southern Alberta and Saskatchewan (Atton and Merkowsky 1983; Nelson and Paetz 1992), and in waters entering Hudson Bay in northwestern Manitoba (Scott and Crossman 1998).

This species uses a wide variety of shoreline habitat types and is often taken by seining in shallow waters (Scott and Crossman 1998; SERM - unpublished data 2001). The use of substrates ranging from rubble to silt-clay, and detritus have been observed for adults, juveniles, and YOY. Large numbers have been captured over sand habitats by seining and they are reported to prefer sand substrate for spawning (Scott and Crossman 1998). The species is also found in areas with submergent and emergent vegetation (Scott and Crossman 1998; SERM - unpublished data 2001). YOY and adults have been found in water depths up to and >10 m and have been captured by trawling (Carlander 1969; Lane *et al.* 1996b,c).

Sand shiner (*Notropis stramineus*)

Sand shiner occur in the Red-Assiniboine River system of southern Manitoba and Saskatchewan (Atton and Merkowsky 1983; Scott and Crossman 1998). This species prefers shallow riffle habitats in Manitoba, in the main stems and tributaries of the Red and Assiniboine rivers. There are only two lacustrine records of the species in Manitoba. One of these is reported as probably erroneous and the other is a single specimen from an Assiniboine oxbow lake (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). In other areas of their geographic distribution sand shiner are reported to associate with sandy shallows of lakes and large rivers where there are rooted aquatic plants (Scott and Crossman 1998). Little information is available on the Canadian populations of this species. In the U.S.A. they are reported to prefer gravel, sand, and silt substrates and associate with in-situ cover (Lane *et al.* 1996c; Scott and Crossman 1998). They are reported to spawn from May to mid-August in Manitoba (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997) and prefer gravel or sand substrates for egg deposition (Lane *et al.* 1996a). Water depths for spawning, YOY rearing, and juvenile use are <2 m while the adults are reported to utilize depths up to and >10 m (Lane *et al.* 1996a,b,c; Scott and Crossman 1998).

Northern redbelly dace (*Phoxinus eos*)

Northern redbelly dace occur in lakes and streams in south-western Saskatchewan in the Cypress Hills region (Missouri drainage basin) (Scott and Crossman 1998) as well as the Saskatchewan River and southern portions of the Churchill drainage basin (Atton and Merkowsky 1983). In Alberta, this species occurs in the South Saskatchewan, North Saskatchewan, and Athabasca River drainages, and lower Peace River. They are thought to occur in the Red Deer River due to the presence of suspected hybrids between this species and finescale dace (Nelson and Paetz 1992). In Manitoba, it is found in headwaters, with a preference for clear, quiet heavily vegetated water throughout south-western Manitoba northward to the Lake Winnipegosis Watershed. This species is part of a species association that is characteristic of bog habitats in headwaters of streams in Eastern Manitoba (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Northern redbelly dace prefer boggy lakes, creeks, ponds, and quiet pool-like expansions of streams and are often found over detritus and silt substrates (Scott and Crossman 1998). Spawning occurs in the spring, often extending into summer (fractional spawning), and eggs are deposited within masses of filamentous algae (Scott and Crossman 1998). This species generally inhabits depths of <2 m, but adults do move into deeper water following a diel migration pattern (Lane *et al.* 1996c).

Finescale dace (*Phoxinus neogaeus*)

Finescale dace are found in streams, lakes, and ponds of southern Manitoba (e.g., Brereton Lake, Telford Pond, and Renie River) and has a distribution similar to *Phoxinus eos* (Scott and Crossman 1998). This species is also part of a species association that is characteristic of bog habitats in headwaters of streams in Eastern Manitoba (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Hybrid schools (hybrids of *Phoxinus eos* and *Phoxinus neogaeus*) are known from headwaters in the Red River and Lake Winnipeg watersheds (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). In Saskatchewan finescale dace occur in the Cypress Hills region of Missouri River drainage and portions of the Saskatchewan River drainage (Atton and Merkowsky 1983; Scott and Crossman 1998). In Alberta, this species is found in the Milk River drainage in the south (Scott and Crossman 1998) and from a few locations in the Hay, Peace, Athabasca, Beaver, upper North Saskatchewan, and Oldman River drainages (Nelson and Paetz 1992).

Generally finescale dace reside at depths up to 2 m (Lane *et al.* 1996c) in cool bog lakes, sluggish creeks (Nelson and Paetz 1992), streams, and large ponds (Scott and Crossman 1998), and often in association with aquatic vegetation and in-situ cover (Lane *et al.* 1996c). They are a spring-spawning species and select areas under debris such as submerged logs and brush piles for egg deposition (Nelson and Paetz 1992; Lane *et al.* 1996a). Substrates in spawning locations are reported to include gravel, sand, and silt (Lane *et al.* 1996a).

Fathead minnow (*Pimephales promelas*)

Fathead minnow occur in large numbers in muddy creeks, ponds, and lakes of south and central Manitoba (north to Lake Athapapuskow and God's Lake), Saskatchewan (north to parts of the Churchill River drainage), and Alberta (Nelson and Paetz 1992; Scott and Crossman 1998). Scott and Crossman (1998) report that fathead minnow occur in the Peace River in western Alberta, where sparse populations may exist, but Nelson and Paetz (1992) found no records of it. Fathead minnow has probably been introduced into many waters east of the Rocky Mountains due to their popularity as a baitfish (Nelson and Paetz 1992).

Preferred habitat for fathead minnow includes still waters of ponds and they are generally found at depths of <2 m (Lane *et al.* 1996c). This species also associates with submergent and emergent vegetation and in-situ cover. In the Prairie region fathead minnow occur in reservoirs, muddy brooks, and alkaline lakes, sometimes in great numbers. They are found to be one of the more abundance species in the saline lakes in Saskatchewan, able to tolerate up to 10,000 ppm salinity (Scott and Crossman 1998). In the northwest they can be found in muddy streams and mud-bottomed lakes. The fathead is a forage fish that will consume larval insects, vegetation, and detritus (Scott and Crossman 1998).

Spawning begins in the spring at water temperatures of 15.6°C, and often continues into August (fractional spawning) (Scott and Crossman 1998). A spawning site is selected by the males under the cover of large rocks, a log or branch, or rarely a lily pad, in water <3 m deep (Scott and Crossman 1998). The males guard these areas and prepare a spawning surface. The adhesive eggs are deposited on the underside these surfaces in a large mass and cared for and guarded by the male until hatching occurs 4.5 to 6 days later at 25°C (McMillan and Smith 1974; Scott and Crossman 1998). High mortality after spawning is a characteristic of the species.

Flathead chub (*Platygobio gracilis*)

Flathead chub are found in throughout southern Manitoba, Saskatchewan, and Alberta (Atton and Merkowsky 1983; Nelson and Paetz 1992; Scott and Crossman 1998), and as far north as the Slave River in Alberta (Nelson and Paetz 1992). In Saskatchewan, flathead chub are found only in the Saskatchewan River system (Atton and Merkowsky 1983). In Manitoba, they are found in the Assiniboine River west to about the mouth of the Qu'Appelle River, the Red River below the St. Andrews Dam, Lake Winnipeg and the Saskatchewan River, and tributaries of Lake Winnipegosis (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Flathead chub occur primarily in large rivers with high seasonal silt loads and turbidity (Nelson and Paetz 1992). They also frequent backwaters or river margins (Nelson and Paetz 1992) and streams (large and small). This species can be found in both shallow and fairly deep water over mud or rocky bottom, and in slow to fairly swift water (Brown 1971). In Lake Winnipeg, this species has been captured along rocky, wave swept shorelines (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Details have not been reported on their biology in Canada, but available information indicates flathead chub spawn in July and early August, and in the Peace River it is known that this species becomes mature at an age of approximately 4 years (Nelson and Paetz 1992). Spawning is thought to occur in the summer when water levels are at their seasonal low (Scott and Crossman 1998).

Longnose dace (*Rhinichthys cataractae*)

Longnose dace are found commonly in lakes, rivers, and small creeks through Alberta except in the Hay River system in the northwestern part of the province (Nelson and Paetz 1992; Scott and Crossman 1998). This species occurs throughout southern Saskatchewan and Manitoba and reaches as far north as the Churchill River drainage basin (i.e., southern edge of basin) (Scott and Crossman 1998). Most of the information available for this species relates to habitat use in streams, though the species does inhabit lakes and has been observed to inhabit wind exposed shorelines in Lake Winnipeg (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Longnose dace are often associated with waters where there are already lake chub present (Nelson and Paetz 1992).

Spawning has been reported to occur over wave swept inshore areas with cobble, rubble, and/or boulder substrates in lakes (Bradbury *et al.* 1999). Nursery habitats are also found in inshore shallow habitats where the YOY are found to utilize overhanging vegetation for cover. It is thought that the young move off-shore to deeper areas of lakes after approximately four months and occupy areas with swift currents (Bradbury *et al.* 1999). In streams, adults of this species are generally associated with swift flowing waters over gravel or boulder substrates. They are also found in areas with aquatic vegetation and overhead cover and may exhibit similar preferences in lakes (Bradbury *et al.* 1999).

Redside shiner (*Richardsonius balteatus*)

Redside shiners are found only in the Peace River system in Alberta, including Big Mountain, Pinto, and Economy creeks, Wapiti, Smoky, Little Smoky, Simonette, and Beaverlodge rivers, and upper reaches of the Peace River. Although redside shiners are more commonly found in rivers, they are also found in lakes in northern Alberta. As well, redside shiners have been illegally introduced to Lee Lake in southwestern Alberta (Nelson and Paetz 1992; Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793).

Spawning occurs in the spring and takes place in shallow-water over gravel or vegetation (Scott and Crossman 1998). During the summer these fish occur in schools over shoals at depths of <1 to 4 m, with the smaller individuals in shallower areas. They also tend to associate with rooted vegetation. They are rarely seen more than approximately 8 m away from these shoals except at night. At night this species exhibits movements off-shore to the upper layers of deeper waters, often in the centre of a lake (Scott and Crossman 1998).

Creek chub (*Semotilus atromaculatus*)

Creek chub are found in lakes and rivers in southern Manitoba including Lakes Manitoba, Dauphin, Swan, and Winnipegosis, and the Assiniboine and Red rivers (Scott and Crossman 1998). The western limit of their distribution is the upper reaches of the Assiniboine River where they are found in tributaries to this system in Saskatchewan, near the Manitoba-Saskatchewan border (Atton and Merkowsky 1983). They are reported to prefer small, clear streams although they do inhabit the shore waters of small lakes or impoundments (Brown 1971; Lane *et al.* 1996c; Scott and Crossman 1998).

The creek chub are omnivorous and their diet includes primarily invertebrates as well as algae and higher plant tissues. They are also classified a sight feeder and require clear waters in streams because of this (Scott and Crossman 1998).

The lake habitat requirements of this species are not well documented for Manitoba or Saskatchewan. Stream habitats include spring spawning in small gravely areas, immediately above or below riffles, where small depressions or pits are excavated for the eggs (Brown 1971; Scott and Crossman 1998). The females and males leave the eggs to hatch on their own after spawning. This species is also reported to utilize both emergent and submergent cover, prefer sand, gravel, and silt substrates and remain in waters <2 m deep year-round (Lane *et al.* 1996c).

Sucker (Catostomidae)

Quillback (*Carpiodes cyprinus*)

Quillback occur throughout southern and central Manitoba and in the Saskatchewan River system and the Qu'Appelle River in Saskatchewan (Atton and Merkowsky 1983; Scott and Crossman 1998). In Alberta, this species occurs in the South Saskatchewan River, including its headwaters, and in the North Saskatchewan and Red Deer rivers (Nelson and Paetz 1992; Scott and Crossman 1998).

Habitat for this species ranges from clear lakes to turbid rivers in the Prairies (Scott and Crossman 1998). Quillback migrate to spawning areas found in streams, overflow areas of bends of rivers, and bays of lakes, in April and May and spawn from May to July (Nelson and Paetz 1992). They randomly deposit eggs over gravel, sand, or silt-clay substrates (Lane *et al.* 1996a). Nests are not built for their eggs and no care is given to the young (Scott and Crossman 1998). Spawning depths and habitats utilized by YOY are reported as <2 m, occasionally with submergent vegetation, and with sand substrate. Adults are primarily associated with gravel, sand, and silt-clay substrates, and are found at depths between 2 and 5 m (Lane *et al.* 1996c). They also associate with submergent vegetation (Lane *et al.* 1996c).

Longnose sucker (*Catostomus catostomus*)

The habitat of the adult longnose sucker in deep lakes is generally depths >10 m, and they are most abundant in cold (10 to 15°C) oligotrophic lakes (Edwards *et al.* 1983). They have a high affinity for in-situ cover (Bradbury *et al.* 1999) and vegetated areas associated with gravel, sand, and detritus substrates. The total dissolved solid levels of these lakes are <10 to 20 mg/L (Edwards *et al.* 1983), and an acceptable pH range is between 6.6 and 8.2.

Longnose sucker mature at the ages of 5 to 6 years and move to tributary streams to spawn when temperatures exceed 5°C or shortly after ice-out in mid-April to mid-May (Bradbury *et al.* 1999). Spawning depths are reported as up to 1 m (Edwards *et al.* 1983; Scott and Crossman 1998; Bradbury *et al.* 1999). They may also spawn in shallow regions of lakes on wave-swept shores at depths between 15 and 30 cm (Hatfield *et al.* 1972; Edwards *et al.* 1983; Nelson and Paetz 1992; Scott and Crossman 1998; Bradbury *et al.* 1999). Spawning takes place in riffles over gravel, cobble, or rubble substrates, and rarely over sand (Hatfield 1972; Edwards *et al.* 1983; Nelson and Paetz 1992; Scott and Crossman 1998; Bradbury *et al.* 1999). The eggs are deposited over the substrate and fall to the substrate and adhere. The newly hatched young remain in the gravel for one to two weeks, and when spawned in rivers, remain for most of their first summer at water depths of approximately 15 cm and then drift into lakes (Edwards *et al.* 1983). YOY are found in shallow, quiet waters with submergent and emergent vegetation cover, and around boulders, rubble, and gravel in depths up to 1 m (Edwards *et al.* 1983). Juvenile habitat consists of shallow, vegetated areas of lakes similar to YOY, with depths <5 m, and with some current on the surface. As they grow older they change from a planktivorous feeder to a benthic feeder and are known to ingest plants, algae and detritus (Bradbury *et al.* 1999).

White sucker (*Catostomus commersoni*)

White sucker occur throughout Alberta in the Hay, Slave, Peace, Athabasca, Beaver, North Saskatchewan, Battle, Red Deer, Bow, Oldman, South Saskatchewan, and Milk River drainages (Nelson and Paetz 1992). However, the white sucker does not extend into the Rocky Mountains (Nelson and Paetz 1992). They are also found in all of Saskatchewan and most of Manitoba (Scott and Crossman 1998).

White sucker are known as fish of warmer shallow waters (Scott and Crossman 1998). They are found on the bottom of rivers in water <5 m deep, and in shallow and deep lakes at approximately 5 to 15 m of depth (Durbin and Fernet 1979; Bradbury *et al.* 1999). They are highly associated with in-situ cover including large woody debris and shady sections of streams (Bradbury *et al.* 1999). Their substrate associations are reported as rubble, sand, silt-clay (SERM - unpublished data 2001) and the pelagic zone (Bradbury *et al.* 1999). White sucker are moderately active during the day and near sunrise and sunset they become increase activity levels and move into shallower water (Scott and Crossman 1998).

White sucker mature at the age of 5 or 6 years and they travel to tributary streams or beaches of lakes (specifically in Alberta) to spawn. Spawning occurs from mid-May to early July, when water temperatures are approximately 10°C (Nelson and Paetz 1992). The spawning sites on some streams are reported to have areas of gravel, sand, and decaying vegetation (Durbin and Fernet 1979). Spawning occurs in shallow (<1 m), gravel riffle sections of streams, rapids, and less frequently along lake margins that have substrates of gravel, sand, silt and clay (Nelson and Paetz 1992; Bradbury *et al.* 1999; SERM - unpublished data 2001). Spawning cover consists of emergent vegetation (SERM - unpublished data 2001). Eggs are released into the water and either adhere to the substrate in the spawning area or drift downstream (Bradbury *et al.* 1999). They hatch in approximately two weeks (Scott and Crossman 1998) and fry begin their migration back to the lakes one month after spawning occurs (Bradbury *et al.* 1999).

In lakes YOY are found in shallow-water along the shore in depths up to 5 m over mucky substrate, and occasionally in the pelagic zone. They move into deeper waters when summer temperatures rise to 30°C. YOY are infrequently found at depths between 5 and 10 m. They move to deeper waters as they grow and become benthic feeders. When there is a decline in food, the suckers have been known to ingest detritus (Bradbury *et al.* 1999). Juveniles prefer depths <5 m and are occasionally found between 5 and 10 m (Durbin and Fernet 1979; Nelson and Paetz 1992; Bradbury *et al.* 1999). Juveniles frequently occur over rubble, cobble, sand, and silt-clay substrates, as well as over detritus, and in the pelagic zone (Bradbury *et al.* 1999; SERM - unpublished data 2001). Juveniles and adults are found associated with the cover of emergent vegetation, but are also found in areas with no cover (SERM - unpublished data 2001).

Bigmouth buffalo (*Ictiobus cyprinellus*)

Bigmouth buffalo are limited to the Qu'Appelle drainage basin in southern Saskatchewan (Atton and Merkowsky 1983; Scott and Crossman 1998). In Manitoba they are found in the Red River and Assiniboine to at least Portage la Prairie. Two specimens have been collected in Lake Manitoba, near the mouth of the Assiniboine floodway, and there is one record from the Icelandic River, a tributary on the west side of Lake Winnipeg (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). This species inhabits shallow depths in slow-moving large rivers, flood plain lakes, reservoirs, sloughs, , and shallow lakes (Scott and Crossman 1998). The optimum habitat for bigmouth buffalo is typically low velocity areas (0 to 70 cm/s), with abundant vegetation for spawning and food sources (i.e., quiet embayments). Other features of their preferred habitat include a pH range of 6.5 to 8.5, a minimum dissolved oxygen (D.O.) of 5.0 mg/L, and a water temperature range of 31 to 34°C for the adults (Edwards *et al.* 1983).

Spawning is positively related to rising water levels and flooded terrestrial vegetation from April to June. Bigmouth spawn in shallow-water over vegetation and scatter their adhesive eggs randomly (Edwards *et al.* 1983). Optimum success in spawning, egg incubation and hatching require a temperature of 15 to 18°C with a maximum of 26°C. A drop in water level after spawning will reduce reproductive success (Edwards *et al.* 1983). Shallow backwaters and marshes in riverine habitats and protected embayments in lacustrine habitats are preferred spawning locations (Edwards *et al.* 1983). In the Qu'Appelle drainage system of Saskatchewan (SERM - unpublished data 2001), it was noted that the eggs hatched in July and the YOY were found in locations where there was no vegetation, over rocky substrate. Juveniles were found in areas with no vegetation over sand, and adults were in areas with pondweed and rocky substrate in the summer months. Juveniles and adults are reported to be found in pelagic zones of Montana lakes and large rivers (Brown 1971). Lane *et al.* (1996c) and Brown (1971) found adults of this species to inhabit depths of 2 to 10 m year-round.

Silver redhorse (*Moxostoma anisurum*)

Silver redhorse are found as far north as the Nelson River in Manitoba (Scott and Crossman 1998), in the Saskatchewan and Qu'Appelle drainages in Saskatchewan (Atton and Merkowsky 1983; Scott and Crossman 1998), and in the lower reaches of the North and South Saskatchewan rivers in Alberta (Nelson and Paetz 1992).

Silver redhorse have never been abundant in Canada and what little information is known about them is based on Ohio records. They are bottom feeders inhabiting large, slow, low-gradient rivers and, less frequently, lakes (Nelson and Paetz 1992). They avoid substrates consisting of heavy silt and fine sediment, areas of pollution, and remain sedentary during the summer in association with gravel substrate (Scott and Crossman 1998).

Maturity is reached at 5 years of age in Alberta (Nelson and Paetz 1992; Scott and Crossman 1998). They migrate out of larger bodies of water in the spring and into the main channel of turbid rivers to spawn on gravel and rubble substrate in <1 m of water. Water temperatures are approximately 13°C during spawning (Scott and Crossman 1998). YOY have a low affinity for lakes but will occupy lake habitat at depths up to 2 m, in areas with hard or soft substrates, with overhead cover (Scott and Crossman 1998), and with emergent vegetation (Lane *et al.* 1996b). In lakes, adult silver redhorse utilize depths of <5 m and are found over substrates ranging from rubble to clay (Lane *et al.* 1996c).

Shorthead redhorse (*Moxostoma macrolepidotum*)

Shorthead redhorse occur from the North Saskatchewan River south in Alberta (Nelson and Paetz 1992), from the Belanger River south in Saskatchewan (Atton and Merkowsky 1983), and from the Churchill River south in Manitoba (Scott and Crossman 1998). This species is found only in rivers in Alberta (Nelson and Paetz 1992).

Shorthead redhorse are bottom feeders and inhabit shallow, clear water lakes or rivers. They associate with substrates consisting of sand or gravel, without heavy silt (Scott and Crossman 1998). They can withstand temperatures as high as 37.2°C (Scott and Crossman 1998).

Maturity is reached at 4 or 5 years of age in Saskatchewan and 3 years of age in Alberta (Nelson and Paetz 1992; Scott and Crossman 1998). This species is not known to spawn in lakes in the Prairie region, but may spawn in lakes in other geographic areas (Lane *et al.* 1996a). They migrate out of larger bodies of water in the spring into smaller, clear rivers, streams, or creeks (Nelson and Paetz 1992) to spawn over gravel riffles when water temperatures are approximately 11°C (Scott and Crossman 1998). YOY also have a low affinity for lakes but occupy habitat reported as <2 m in depth, in areas with gravel and sand substrates (Lane *et al.* 1996b). In lakes, adult shorthead redhorse utilize depths of <5 m, have some association with submergent vegetation, and are found over substrates ranging from rubble to silt (Lane *et al.* 1996c).

Bullhead catfish (Ictaluridae)

Black bullhead (*Ameiurus melas*)

Black bullhead are limited to the Qu'Appelle-Souris-Assiniboine River systems in Saskatchewan and Manitoba (Atton and Merkowsky 1983; Scott and Crossman 1998). In Manitoba, they are abundant in the Red, Assiniboine and Souris River watersheds. They also occur in Lake Winnipeg and appeared in Lake Manitoba following the opening of the Assiniboine River Floodway (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Adults are found year-round in water depths up to 2 m, in areas with emergent vegetation and sand and silt substrates (Lane *et al.* 1996c). They are usually found in lower sections of small- to medium-sized streams with low gradient, ponds, backwaters of larger rivers and silty, soft-bottomed areas of lakes or impoundments. They are reported to be common in lakes (Lane *et al.* 1996c).

Spawning takes place in the spring between May and June at water temperatures of approximately 21°C. Areas with cover in shallow littoral zones are preferred (Stuber 1982). Spawning has also been reported to extend to early summer (Scott and Crossman 1998). The eggs are deposited in a nest the female excavates by pushing away substrate and debris. The spawning areas are more commonly found in substrates of sand and silt or clay where there is a moderate to heavy growth of submergent vegetation (Stuber 1982; Lane *et al.* 1996a). The eggs generally hatch within five days and newly hatched black bullhead brood school in the area of the nest for approximately two weeks (Scott and Crossman 1998). Black bullhead are primarily nocturnal. However, YOY exhibit a diurnal pattern with high activity periods just before dawn and just after dark (Scott and Crossman 1998).

Brown bullhead (*Ameiurus nebulosus*)

Brown bullhead occur in southern Manitoba in the Red River system as well as portions of the Whitesand-Assiniboine system (Qu'Appelle drainage basin) in southeastern Saskatchewan (Atton and Merkowsky 1983; Scott and Crossman 1998). In Manitoba their distribution is similar to the black bullhead although their range extends north to the Mukutawa River on the east side of Lake Winnipeg and into Lake Manitoba (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). This species occurs at depths <5 m (Lane *et al.* 1996c) near, or on, the muddy bottom in warm waters of small lakes, shallow bays of larger lakes, and larger, slow-moving streams with abundant submergent and emergent vegetation (Scott and Crossman 1998). The substrates more specifically tend to be gravel, sand, and silt-clay (Lane *et al.* 1996c).

When water temperatures reach 21°C in the months of May and June, brown bullhead spawn in shallow nests cleared by both sexes (Scott and Crossman 1998). The nests are made in a variety of locations including areas of mud or sand substrates, always associated with roots of aquatic vegetation, and protected by stumps, rocks, or trees (Lane *et al.* 1996a). Burrows are sometimes built in the substrate (Scott and Crossman 1998) and in locations where submergent and emergent vegetation occur to provide spawning habitat (Lane *et al.* 1996a). The water over these nesting sites can be as shallow as 10 cm or as deep as 1 to 2 m around the shores of lakes, or in coves, bays, or creek mouths (Scott and Crossman 1998). The eggs are cared for and oxygenated by one or both parents for up to nine days prior to hatching at temperatures of 21 to 23°C (Scott and Crossman 1998). Approximately seven days after hatching the YOY can swim and feed, still school and are guarded by the parent(s) until they approximately 50 mm in length.

Their preferred habitat is over rubble, cobble, and sand substrates at a depth up to 2 m (Lane *et al.* 1996b). YOY also frequent areas where the substrates are clay or silt and where submergent and emergent vegetation occurs (Lane *et al.* 1996b). Adult brown bullhead are omnivorous and feed mainly at night on or near the bottom, sometimes to depths of 14 m (Scott and Crossman 1998). They are very tolerant to temperature changes and can acclimate from 6 to 36°C, and can survive a winter with dissolved oxygen levels of 0.2 ppm (Scott and Crossman 1998).

Channel catfish (*Ictalurus punctatus*)

Channel catfish are found in Manitoba in the Red River, the Assiniboine River, Lake Winnipeg north to the Poplar River (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). They first appeared in Lake Manitoba following the opening of the Assiniboine River Floodway (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). There have also been a few reports of fish being caught in the lower Qu'Appelle River in eastern Saskatchewan (Atton and Merkowsky 1983; Nelson and Paetz 1992).

Channel catfish inhabit lakes and large rivers that are cool, clear, and deep with sand, gravel, or rubble bottoms (Peters *et al.* 1989). The reported depth preference for adults in lakes is <5 m year-round. They will inhabit shallow, turbid, and vegetated areas (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997) but are reported to have less of an affinity for these areas than black bullhead (Lane *et al.* 1996c; Scott and Crossman

1998). They are omnivorous and have been known to feed on aquatic algae, aquatic plants, berries, and seeds (Brown 1971). In Manitoba the adults are reported to be mainly piscivorous, feeding on a wide variety of species, including sauger and goldeye. They also feed on crayfish, frogs, and leeches, and will take dead fish that are small enough to swallow (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). During the day they are found in deep holes protected by rocks or logs. In the Red river, they are reported to move over great distances, with individuals tagged below the St. Andrews Dam being recaptured as far away as Brandon (before the building of the Assiniboine River Floodway Diversion Structure) and Drayton, North Dakota (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). One radio-tagged individual (originally captured in the lower Red River off the mouth of Cook's Creek) moved approximately 45 km down into Lake Winnipeg and then up the Brokenhead River to Scanterbury in a seven-day period (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

They are known to spawn in the Red and Assiniboine rivers, and many (probably not all) of the young move down into Lake Winnipeg. The juveniles are known to ascend streams on the east side of the lake, north to the Poplar River. At sexual maturity (approximately 10 years of age in Manitoba) the adults move back into Lake Winnipeg and back into the Red River to spawn (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Adults move between the Red River and Lake Winnipeg, feeding in both habitats, but are seldom seen in the tributaries on the east side of the lake, which is utilized by the juveniles. Adults do not spawn every year, but the interval between spawning is not known (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Channel catfish spawn in late spring or summer (May to July) at temperatures between 23.9 and 29.5°C, with 26.7°C being the optimum (Brown 1971). They are reported to spawn in both rivers and lakes and inhabit areas with the cover of holes, undercut banks, log jams, or rocks at depths up to 5 m (Lane *et al.* 1996a). In the Red River, they spawn on rocky substrate consisting of exposed glacial till or limestone outcrops which transect the river at several locations (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Nests are constructed within these areas and the eggs are deposited. Hatching occurs five to ten days later at temperatures from 15.6 to 27.8°C (Scott and Crossman 1998). The fry remain on the bottom for two to five days and then can be found on the surface where they feed (Scott and Crossman 1998). The YOY and juveniles can be found migrating from lakes into the fast water of tributary rivers at night to feed (Scott and Crossman 1998). YOY habitat use in lakes has been reported as: depths of 2 to 5 m in spring and >5 m in the fall; a limited association with vegetation; and, a preference for gravel and rubble substrates (Lane *et al.* 1996b).

Tadpole madtom (*Noturus gyrinus*)

Tadpole madtom are found in the Red River, Lake Winnipeg north to the Berens River, the Assiniboine and Souris rivers, and appeared in Lake Manitoba after the opening of the Assiniboine River Floodway (Scott and Crossman 1998; Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). They also occur in the Souris River system in Saskatchewan (Atton and Merkowsky 1983).

Tadpole madtom habitat is known to be quiet, slow-moving, clear waters, shallows of lakes and their outlets, sloughs, ponds, backwaters, and stream mouths (Scott and Crossman 1998). They prefer areas with soft, muddy substrates and vegetative cover but do occur in areas with boulder, cobble, gravel, and sand substrates (Lane *et al.* 1996c). During the day they seek cover in the protection of cavities, cutbanks, debris, or vegetation and are known to occur to a depth of 25 m (Lane *et al.* 1996c; Scott and Crossman 1998). Tadpole madtom exhibit a preference for spawning in rivers but will spawn in shallow-water in lakes (Scott and Crossman 1998). Spawning occurs during summer, at depths of <2 m, in nests built in cavities, and is generally associated with aquatic vegetation or in-situ cover (Lane *et al.* 1996a). The eggs cluster and adhere to one another and to the substrate (Scott and Crossman 1998). YOY remain at depths of <2 m, in areas of sand and silt substrates, and are also strongly associated with aquatic vegetation (Lane *et al.* 1996b).

Pike (Esocidae)

Northern pike (*Esox lucius*)

Northern pike are found in lakes and marshes throughout Alberta, Saskatchewan, and Manitoba (Atton and Merkowsky 1983; Ford *et al.* 1995; Scott and Crossman 1998). Although they are relatively common through most of Alberta (Petitot, Hay, Slave, Peace, Athabasca, Beaver, North Saskatchewan, Battle, Red Deer, Bow, Oldman, South Saskatchewan, and Milk River drainages), they are rare in the Rocky Mountains and adjacent foothills. Northern pike prefer heavily vegetated (submergent and emergent), shallow, clear waters of lakes and marshes, although they can be found in streams with slow to moderate current (Nelson and Paetz 1992).

Northern pike spawn in the early spring before the ice has completely left the lakes. Maturation age is generally 2 years for males and 3 years for females (Brown 1971). The water temperatures during spawning are generally between 4 and 12°C (Scott and Crossman 1998). Spawning depths are generally reported as <1 m, and always at depths <10 m (Lane *et al.* 1996a). Spawning-site preference is more related to adequate submergent vegetation than to actual substrate as they have been reported to use emergent, submergent, and flooded vegetation occurring over a wide variety of substrate materials (Ford *et al.* 1995; Lane *et al.* 1996a; Bradbury *et al.* 1999). Northern pike move from deep areas of lake systems, where they spend their winters (Brown 1971), to shallow marshes connected to lakes or flooded vegetation in shallow bays (Nelson and Paetz 1992) to spawn. The adult pike move out of the spawning areas immediately after spawning (Brown 1971) but remain in shallow, vegetated areas of lakes with adequate cover (Sawchyn 1973; Ford *et al.* 1995).

The eggs adhere to the vegetation and hatch in two weeks and the larval northern pike remain attached to vegetation for about the first week (Nelson and Paetz 1992). The YOY frequent depths of up to 1 m in the spring and are found along the shoreline, over substrates that are silt, clay or hardpan clay near cover of submergent and emergent vegetation (Lane *et al.* 1996b; Golder 1997; Bradbury *et al.* 1999). Juveniles typically remain along shorelines with adequate food and cover at depths of <2 m (Ford *et al.* 1995). Their preferred substrate is the same as the YOY and they are always found in association with submergent vegetation. The adults also prefer shallow habitats (<5 m) and are generally found along the margins of vegetated areas with some cover or areas with in-situ materials (fallen logs, tree stumps, shoals, and boulders). Substrates in these areas tend to be mud, silt, or hardpan clay (Sawchyn 1973; Ford *et al.* 1995; Bradbury *et al.* 1999). The optimal temperatures for adult pike are between 19 and 21°C (Ford *et al.* 1995).

Spawning success has been linked to elevated water levels and newly flooded terrestrial habitat. This results in both increased flooded vegetation for use as spawning substrate, and increased nutrients which may lead to less cannibalism due to increased food supply (Casselman and Lewis 1996).

Muskellunge (*Esox masquinongy*)

Muskellunge only occurs in waters in southeastern Manitoba. It is native, but rare in the Winnipeg River drainage, has been introduced to the Assiniboine River drainage, and may occur in the Lake Manitoba drainage area (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Muskellunge can be found in warm, heavily vegetated lakes, stumpy, weedy bays, and slow, heavily vegetated rivers (Scott and Crossman 1998). Muskellunge rarely stray from the protection of the emergent and sub-emergent cover. Their optimal temperature is 25.6°C, and they can withstand low summer oxygen levels in sluggish, shallow habitats. Large individuals are found over deeper, less-vegetated water up to 17.5 m in depth (Scott and Crossman 1998).

Muskellunge is a spring spawner and spawning is initiated after breakup when water temperatures are 9.4 to 15°C in late April or early May (Scott and Crossman 1998). Spawning sites are generally in water <0.5 m deep in heavily vegetated and flooded areas (Scott and Crossman 1998) but will occur at depths of up to 2 m (Lane *et al.* 1996a). The eggs are dispersed onto the vegetation and the fry emerge in eight to fourteen days when water temperatures are between 11.7 and 17.2°C (Scott and Crossman 1998). The fry remain on the vegetation for approximately ten days and then become active (Scott and Crossman 1998) swimming at the surface in areas of <1 m of water and avoiding contact with the bottom substrate (Cook and Solomon 1987). YOY habitats are reported as areas with sand and silt substrate, submergent vegetation, and generally <2 m deep (Lane *et al.* 1996b). Juvenile daily movements are reported to be confined within a range of approximately 100 m in open water (Cook and Solomon 1987).

Trout (Salmonidae)

Cisco (*Coregonus artedi*)

Cisco is known to occur in lakes throughout Manitoba and central-northern Saskatchewan including the Qu'Appelle River system, and eastern Alberta (Scott and Crossman 1998). In Alberta, cisco was introduced to Spray Lakes Reservoir, east of Banff, and in the Bow River drainage. Cisco was also successfully stocked in Lake Minnewanka in Banff National Park in 1916 and 1917 (Nelson and Paetz 1992). The other river drainages that are occupied by cisco are the Slave, Peace, Athabasca, and Beaver (Nelson and Paetz 1992).

Cisco adult habitat is reported as primarily the pelagic zone of lakes. However in late summer, cisco move just below the thermocline and, as upper waters cool, they move to shallower waters (Scott and Crossman 1998). In the Qu'Appelle drainage system of Saskatchewan, the adults were located in emergent vegetation over silt substrate in May, and in October they were observed to inhabit non-vegetative areas on sand and rock (SERM - unpublished data 2001). They spawn in November or early December when water temperatures drop to 2.0 to 5.0°C (Nelson and Paetz 1992). Spawning times are temperature dependent and can vary within lakes, particularly large lakes, because of this. The location of spawning is generally in shallow water, 1 to 3 m deep, often over a gravel or stony substrate (Scott and Crossman 1998). The optimum incubation temperature is approximately 5.6°C. Hatching does not occur until after break up in southern Canada (Scott and Crossman 1998) and is usually in April or May (Nelson and Paetz 1992). A study from the Qu'Appelle drainage system of Saskatchewan showed that in May the juveniles were located in habitats of sparse vegetation, over rock substrate, and in October they tended to be in non-vegetated areas over rock (SERM - unpublished data 2001). Maturity is reached, on average, at the age of 3 years (Nelson and Paetz 1992).

Lake whitefish (*Coregonus clupeaformis*)

Lake whitefish are distributed throughout the Prairie Provinces, except for extreme southern portions of Saskatchewan in the Missouri drainage, and in Manitoba in the Missouri drainage and southern portions of the Red River drainage (Scott and Crossman 1998). In south-central Alberta, lake whitefish have been introduced into larger lakes as a forage fish or in the hopes of establishing commercial fisheries (Nelson and Paetz 1992; Scott and Crossman 1998). Lake whitefish were introduced into Lake Minnewanka, Banff National Park, in the 1950s with mixed success, and is thought to be the source of lake whitefish in Ghost Reservoir, downstream of the lake (Nelson and Paetz 1992).

Adult lake whitefish generally mature at the age of 6 to 9 years and spawn annually (Machniak 1975a). They move into the shallow waters of lakes in the fall to spawn on shoals or rocky ledges (Ayles 1976). More specifically, depths up to 5 m in small lakes with boulder, cobble, rubble, and gravel substrates are preferred (Machniak 1975a). In large lakes spawning has been reported at depths of >10 m (Machniak 1975a). Infrequently, spawning occurs on silt and clay substrates with emergent vegetation, but has not been observed over detritus substrate (Lane 1996a). In Heming Lake, Manitoba, spawning occurs in October and is known to occur progressively earlier, the further north specific water bodies are located (Scott and Crossman 1998). In the Prairie Provinces, spawning times are reported to occur from: the end of October to early November at water temperatures of approximately 6°C in Manitoba; late September to January at water temperatures of 1 to 9.2°C Alberta; and, late October to mid-November at water temperatures of 5.5°C in Saskatchewan (Machniak 1975a). Generally, the ideal temperatures are between 0.5 and 7.8°C, with peak activity at 2°C (Ayles 1976). The fertilized eggs hatch in April or May (Scott and Crossman 1998).

When the YOY first hatch they are attracted to light and thus swim to the surface layers of the water and are found at depths of up to 2 m (Machniak 1975a). In the summer, the YOY leave the shallow inshore waters and move into deeper pelagic waters at depths between 5 and 10 m with substrates of boulder, cobble, gravel and sand (Lane *et al.* 1996b). In Wollaston Lake, Saskatchewan, YOY were captured in shoreline seine hauls during the summer. Sawchyn (1973) attributed their presence in this habitat during the summer to the colder water temperatures of this lake when compared to more southern lakes. On occasion the YOY can be found near submergent and emergent vegetation, but infrequently are found over in-situ cover (Machniak 1975a). Juveniles are found at depths up to 10 m, and occasionally >10 m (Lane *et al.* 1996c). The seasons that juveniles change depths have not been defined (Bradbury *et al.* 1999). Their preferred habitats are areas with boulders, cobble, rubble, and gravel substrates, and pelagic areas. Their ideal cover consists of emergent vegetation, and infrequently in-situ cover (Lane *et al.* 1996c).

Shortjaw cisco (*Coregonus zenithicus*)

Shortjaw cisco are only found in a few lakes in the prairies, including Barrow Lake, Alberta (Nelson and Paetz 1992), Lake Athabasca and Reindeer Lake, Saskatchewan (Atton and Merkowsky 1983). In Manitoba they have been observed in Lake Winnipeg and in the Winnipeg, Saskatchewan, and Churchill River drainages (Scott and Crossman 1998; Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Much of the information available for this species is from the Great Lakes region of Canada. This is primarily a pelagic, deep-water species occurring in depths from 1 to 10 m but preferring depths >10 m (Lane *et al.* 1996c; Scott and Crossman 1998). Spawning in the Great Lakes region is reported to occur in late November or early December (Carlander 1969; Scott and Crossman 1998). Spawning is generally in water >5 m deep over substrates ranging from boulder to clay with a preference for sand and hard-pan clay (Lane *et al.* 1996a; Scott and Crossman 1998). Little is known about YOY or juvenile habitat; it is assumed they inhabit depths >10 m (Nelson and Paetz 1992; Lane *et al.* 1996b,c; Scott and Crossman 1998).

Golden trout (*Oncorhynchus aguabonita*)

In Alberta, golden trout are an introduced species and are found in several high-altitude lakes in the southern Rocky Mountains (Carlander 1969; Nelson and Paetz 1992). This species can be found in the Castle River system in the Oldman River drainage including the Barnaby Ridge Lakes and Rainy Ridge Lake, in the North Saskatchewan River drainage in Michele Lakes southwest of Nordegg, and in the Cline River drainage (i.e., Coral Lake) (Nelson and Paetz 1992; Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793).

In Alberta, spawning occurs in early July. Rainbow trout and golden trout have similar habitat requirements and life histories. Golden trout is, however, more adapted to higher elevations than other salmonids (Scott and Crossman 1998).

Spawning does occur in lakes (Carlander 1969; Nelson and Paetz 1992) over gravel substrate (Carlander 1969).

Cutthroat trout (*Oncorhynchus clarki*)

Cutthroat trout occur in the headwaters of the Athabasca, North and South Saskatchewan, and Milk rivers in Alberta (Nelson and Paetz 1992; Scott and Crossman 1998) although the species is not native to the Athabasca and North Saskatchewan drainages (Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793). This species has been introduced into several lakes in Banff National Park, including Marvel Lake and Redoubt Lake (Nelson and Paetz 1992), and into Job Lake and many other barren lakes in Alberta's Eastern Slopes. In Saskatchewan cutthroat trout have been stocked in Lock Leven since 1993 and a reproducing population is established (Ron Jensen August 2001, pers comm. SERM ph [306] 778-8210). It has also been introduced into several Manitoba lakes in the Whiteshell and Duck Mountain Provincial Parks (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Cutthroat trout in the prairies spawn almost exclusively in small, gravel-bed streams in spring and early summer, approximately three to five weeks after ice breakup when the water temperature reaches 10°C (Scott and Crossman 1998). Lake spawning is assumed where there are no inlet or outlet streams to the lake and a self-sustaining population of cutthroat trout exists (Nelson and Paetz 1992). Spawning occurs in streams that are located under forest canopy as well as in open-meadow habitats (Gresswell 1988) at depths up to 1 m. A redd is created in clean gravel (Carlander 1969; McIntyre and Rieman 1995; Scott and Crossman 1998) cobble and occasionally sand (Gresswell 1988; Nelson and Paetz 1992; Ford *et al.* 1995). There is a high adult mortality rate following spawning as well as a high mortality rate for eggs in the redd. The eggs hatch in six to seven weeks and the alevins remain in the redd for one to two weeks more (Scott and Crossman 1998). Fry emergence is generally in August and the young congregate in shallow, slow-moving parts of the stream prior to moving to a large river or lake system (Gresswell 1988). The surviving adults also move out of the streams shortly after the young migrate (Gresswell 1988). Some young may stay in the smaller streams for a few years as juveniles, and others may live their whole lives in large, gravel-bed pools located in streams (Scott and Crossman 1998). Fry, Juvenile, and adult cutthroat trout are associated with in-situ cover in the winter months (Meehan and Bjornn 1991), and the juveniles have been known to bury themselves in the substrate in winter (Young 1995).

Little is known about habitat associations in lakes; however, they are known to utilize in-situ cover and prefer gravel substrate.

Rainbow trout (*Oncorhynchus mykiss*)

Rainbow trout occur in central and southern Manitoba, Saskatchewan, and Alberta (Scott and Crossman 1998). Several small native populations are known to exist in the Athabasca River drainage basin (Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793). Rainbow trout have been introduced into several areas such as the Saskatchewan River system in Saskatchewan, portions of the McLeod River system, upper reaches of the South Saskatchewan and North Saskatchewan River in Alberta, and a few lakes in Wood Buffalo National Park. No reproduction is known to occur in many of these lakes (Nelson and Paetz 1992). In Manitoba introductions have occurred in Williams Lake, and in the Winnipeg, Assiniboine, and Lake Winnipeg drainages (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). Rainbow trout in Lake Diefenbaker, Saskatchewan, are reported to be spawning in at least one tributary stream (Ron Jensen, SERM pers. comm. February 2001, ph. [306] 778-8210). In Saskatchewan this species is also found in streams of the Mississippi drainage basin and occasionally inhabits the East End Reservoir (Ron Jensen August 2001, pers comm. SERM ph [306] 778-8210).

Rainbow trout inhabit areas of cool waters, optimally below 20°C and well oxygenated. This species inhabits both streams and lakes (Nelson and Paetz 1992) but has a higher affinity for streams (Lane *et al.* 1996c). Adult rainbow trout are found at variable depths, depending on water temperatures and this is reflected in their pelagic habitat use rating specified in Lane *et al.* (1996c). Their preference is for depths up to 10 m year-round; however, in the winter, they utilize shallower depths of 1 to 2 m (Raleigh *et al.* 1984; Ford *et al.* 1995; Scott and Crossman 1998; Bradbury *et al.* 1999). In general, adult habitat is reported to include substrates ranging from cobble to boulder, with cover of debris and boulders (Ford *et al.* 1995).

Maturity is reached by age 3 or 4 years and spawning typically occurs in small tributaries or rivers (Nelson and Paetz 1992). Spawning infrequently occurs in lakes but has been observed in inlet or outlet areas (Ford *et al.* 1995). The depth of the spawning site is typically from 0.15 to 2.5 m in currents of 30 to 90 cm/s, yet they have also been known to spawn at depths of 2 to 5 m (Ford *et al.* 1995). Spawning sites are rarely associated with submergent and emergent vegetation (Bradbury *et al.* 1999). Rainbow trout spawn at 6 to 10°C in early spring (mid-April) (Nelson and Paetz 1992; Scott and Crossman 1998). The females dig a redd in a bed of gravel, and occasionally rubble, in a riffle above a pool. The eggs are deposited in the redd, fertilized, and after spawning the eggs are covered by the gravel to develop within the substrate (Nelson and Paetz 1992; Scott and Crossman 1998). The eggs hatch in four to seven weeks, and the fry begin feeding fifteen days after hatching in mid-June to mid-August and travel to lake habitat by autumn (Scott and Crossman 1998). Native (Athabasca River drainage) and introduced rainbow trout in southern Alberta have some differences in biology and spawning. Native northern trout spawn later than the southern trout, in late June at temperatures of approximately 6°C, with the egg incubation period temperature averaging between 6.3 and 9.8°C. Hatching occurs in September (Nelson and Paetz 1992).

If they are a stream-resident population, fry will remain in streams (Scott and Crossman 1998). In lakes, YOY are considered pelagic (Bradbury *et al.* 1999) preferring depths up to 2 m in the spring, and up to 5 m year-round (Raleigh *et al.* 1984); they are rarely associated with depths >5 m. Both YOY and juveniles prefer in-situ cover (Meehan and Bjornn 1991), and both are associated with boulders, rubble, and cobble substrates (Raleigh *et al.* 1984; Ford *et al.* 1995;

Bradbury *et al.* 1999). YOY will also use gravel, sand, and silt-clay substrates (Raleigh *et al.* 1984; Lane *et al.* 1996b; Bradbury *et al.* 1999). The preferred habitat for juveniles is along the margins of lakes or streams, from depths of 3 to 6 m in lakes. Juveniles rarely use areas of gravel or sand substrates and submergent or emergent vegetation cover (Raleigh *et al.* 1984; Bradbury *et al.* 1999).

Pygmy whitefish (*Prosopium coulteri*)

Pygmy whitefish are found only in few areas in Alberta including Waterton Lake and Solomon Creek (west of Hinton near the Athabasca River). There are also reports of pygmy whitefish occupying the lower reaches of Snake Indian River in Jasper National Park (part of the Athabasca River drainage) (Nelson and Paetz 1992). Virtually nothing is known of their biology in Alberta; however, in British Columbia they have been found in deep water of lakes, traditionally deeper than 7 m (Scott and Crossman 1998), and from Montana to Alaska in mountainous regions (Nelson and Paetz 1992).

Generally, pygmy whitefish carries out all of its life stages in lakes (Lane *et al.* 1996a,b,c). They are a deepwater species that seems to have an unchanged variability of depth from season to season (Scott and Crossman 1998). Adults are commonly found at depth between 5 and >10 m year-round. They have a high affinity for substrates that are sand or silt-clay. On occasion the adults are associated with gravel substrate but infrequently are found over muck and detritus (Nelson and Paetz 1992; Lane *et al.* 1996c).

Spawning is occasionally associated with shallow water, in streams or lakes in October to December (Nelson and Paetz 1992) depending on the region (Scott and Crossman 1998). They prefer spawning over substrates that consists of rubble and sand (Lane *et al.* 1996a). The fertilized eggs are scattered over the substrate and develop through the winter, hatching in the spring (Scott and Crossman 1998). The YOY are seasonally found at various depths. In the spring they are found at depths of 2 to 5 m while in the fall they are found at depths of 5 to 10 m (Nelson and Paetz 1992; Lane *et al.* 1996b). Their preferred habitat is over sandy substrate (Nelson and Paetz 1992; Lane *et al.* 1996b). Juveniles are found at depths >10 m all year long (Nelson and Paetz 1992).

Round whitefish (*Prosopium cylindraceum*)

Round whitefish are found in northern waters, including lakes and rivers in the Peace-Athabasca Delta, Alberta (Nelson and Paetz 1992), Fond du Lac and Cree River systems of Saskatchewan and portions of the Churchill, Thlewiaza, and Knife rivers in Manitoba (Scott and Crossman 1998; Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Adult round whitefish are found at depths up to and >10 m in lakes (Scott and Crossman 1998; Bradbury *et al.* 1999) and are infrequently found inshore (Golder 1997). They may be found in water temperatures of 17 °C in the littoral zone in the summer (Golder 1997). They have a high affinity for substrates that are sandy, cobble, rubble, muck or hardpan clay (Lane *et al.* 1996c), and they are typically bottom feeders (Scott and Crossman 1998).

This species reaches maturity at approximately 8 years of age (Nelson and Paetz 1992). Spawning takes place in November at water temperatures of approximately 4.5°C. Spawning sites are usually in gravel shallows, up to 1 m deep, of lakes, at river mouths, or on occasion, in rivers (Scott and Crossman 1998). The eggs are deposited on substrates of rubble, gravel, occasionally cobble and infrequently silt and clay (Bryan and Kayto 1975; Lane *et al.* 1996a). They are known to infrequently spawn near the cover of emergent vegetation. The young usually hatch around the end of April and early May (Scott and Crossman 1998). The YOY are found at depths of 2 to 5 m in the spring and >5 m the rest of the year (Lane *et al.* 1996b). The YOY prefer cobble, rubble, gravel, and sand substrates, and in-situ cover. Juvenile round whitefish prefer lakes and are found at variable depths up to 10 m, but most frequently are found schooling in shallow inshore bays of lakes over substrates consisting of cobble and rubble (Golder 1997; Scott and Crossman 1998; Bradbury *et al.* 1999).

Mountain whitefish (*Prosopium williamsoni*)

Mountain whitefish occur in rivers and lakes in western Alberta, including the Milk River, the North and South Saskatchewan rivers, and the upper Peace and Athabasca rivers (Nelson and Paetz 1992; Scott and Crossman 1998). Although mountain whitefish are more commonly found in the western half of the province in the above-mentioned drainages, this species is known to exist in the Slave, lower Peace, and lower Athabasca River drainages (Nelson and Paetz 1992).

Mountain whitefish habitat is typically streams and in shallow portions of lakes (Nelson and Paetz 1992). They are also common in clear, cold rivers with water temperatures between 8 and 14°C (Ford *et al.* 1995). The majority of mountain whitefish populations exhibit relatively consistent migration patterns to different areas for spring and summer feeding, spawning, and overwintering (Nelson and Paetz 1992). Mountain whitefish feed largely on bottom fauna (Nelson and Paetz 1992) at depths less than 3 m over gravel or cobble substrates (Ford *et al.* 1995). They are frequently found deeper than 10 m in the summer season (Northcote 1995).

Mountain whitefish mature between the ages of 3 to 5 years and spawning occurs in late September to early November over gravel shallows in lakes or most commonly over gravel in streams (Nelson and Paetz 1992). Ford *et al.* (1995) reported spawning rarely occurs in lakes. Water temperatures are usually between 0 and 12°C during egg development in waters with some velocity (Ford *et al.* 1995). No nest is built and the eggs are deposited on the substrate at depths of 0.1 to 1.0 m (Ford *et al.* 1995). Spawning is uncommon at depths >5 m; however, pelagic spawning has been observed by Hagen (1970). The eggs hatch between March and late April when ice breakup occurs on the rivers (Nelson and Paetz 1992). In lakes, YOY are reported to prefer habitat with submergent and emergent vegetative cover (Hagen 1970). The YOY also prefer depths of 5 to 10 m (Hagen 1970) and 1 to 2 m (Hagen 1970; Nelson and Paetz 1992). YOY prefer boulder and rubble substrates (Northcote 1995), while juveniles are found over sand or gravel substrates (Ford *et al.* 1995). The juveniles are found in water with temperatures up to 26.6°C and prefer depths <3 m (Nelson and Paetz 1992; Ford *et al.* 1995; Northcote 1995). However, they will inhabit deeper areas and are found at the same depths as adults.

Atlantic salmon (*Salmo salar*)

Atlantic salmon were introduced into Sawback Creek (1959), Cascade River (1959 to 1963), and Lake Minnewanka (1915 to 1923, and 1963) in Banff National Park, and into Moab (1961), Celestine (1962), Pyramid (1917 and 1961), and Patricia (1962) lakes in Jasper National Park, Alberta. There is no evidence to indicate reproduction of this species has occurred in these waters (Nelson and Paetz 1992; Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793). In Saskatchewan, remnant escaped fish from a cage culture operation are captured occasionally in Lake Diefenbaker though no intentional stocking has occurred in this lake (Ron Jensen August 2001, pers comm. SERM ph [306] 778-8210).

Adult Atlantic salmon that are landlocked spawn on gravel beds of tributary streams or on rocky shorelines of lakes (Scott and Crossman 1998). The preferred spawning substrate is gravel, along shorelines, mouths of inlet streams and outlet streams or areas above or below a pool. Depths between 0.5 and 1.3 m are preferred for spawning. Spawning adults have been known to enter spawning streams immediately following freshet, when there is an increased volume of clean, cool water (Bradbury *et al.* 1999). Spawning takes place in the fall generally between September and November. After spawning, the males may overwinter in the same area as the eggs. The eggs incubate within the substrate until April when they hatch at water temperatures of approximately 4°C. The young stay covered in the gravel until May or June and remain in the streams for two to three years. As smolts they return to larger lakes and remain in the shallow upper layers of the lake following ice-breakup. As summer advances, they descend to cooler deeper waters (Scott and Crossman 1998).

Brown trout (*Salmo trutta*)

Brown trout were successfully introduced into the Athabasca, North Saskatchewan, Red Deer, Bow, and Oldman rivers in western Alberta (Nelson and Paetz 1992). Outside of Alberta, brown trout are limited to isolated populations in the streams and lakes in the Cypress Hills region of southwestern Saskatchewan and some waters of southeastern Manitoba (Atton and Merkowsky 1983; Scott and Crossman 1998). In Saskatchewan they are also found in streams of the Mississippi drainage basin and occasionally inhabit the East End Reservoir when they are washed downstream during high flow events (Ron Jensen August 2001, pers comm. SERM ph [306] 778-8210).

The habitat of brown trout life stages is frequently lakes (Nelson and Paetz 1992), though in Alberta stream populations are much more common. Adults are nearly always associated with depths >5 m, and uncommonly <5 m (Raleigh *et al.* 1984; Bradbury *et al.* 1999). Their preferred substrates are rubble and boulders, and frequently silt-clay, muck, and hard-pan clay in the pelagic zone (Bradbury *et al.* 1999). Adults are nearly always associated with overhead and in-situ cover and are frequently associated with submergent vegetation (Raleigh *et al.* 1984; Nelson and Paetz 1992).

Brown trout spawn in fall and early winter in streams at water temperatures between 6.7 and 8.9°C. Generally, the YOY and juveniles remain in streams for one to two years then migrate to lakes for one to two more years after which time they are sexually mature and return to streams to spawn (Meehan and Bjornn 1991). Spawning generally occurs at depths of <2 m over rubble, cobble, and gravel substrates. The YOY prefer depths similar to the spawning site and are infrequently found at depths >2 m (Raleigh *et al.* 1984; Bradbury *et al.* 1999). YOY are nearly always found over substrates of boulder, cobble, and rubble but are also found over gravel and sand (Bradbury *et al.* 1999). They are nearly always associated with overhead and in-situ cover (Raleigh *et al.* 1984; Nelson and Paetz 1992) and rarely associated with submergent vegetation (Bradbury *et al.* 1999). Juveniles strongly prefer at depths up to 5 m, commonly from 5 to 10 m, and rarely >10 m (Raleigh *et al.* 1984). Juveniles are nearly always found over substrates of boulder, cobble, and rubble and commonly over gravel and sand (Bradbury *et al.* 1999). They are rarely encountered in pelagic zones. Juveniles are also strongly associated with overhead and in-situ cover (Raleigh *et al.* 1984; Nelson and Paetz 1992) and on occasion associated with submergent and emergent vegetation (Raleigh *et al.* 1984; Bradbury *et al.* 1999).

Arctic char (*Salvelinus alpinus*)

Arctic char largely occupy waters in Hudson Bay along the northeastern coast of Manitoba. Although this species primarily inhabits coastal waters, the Arctic char may enter larger rivers and inland lakes (Scott and Crossman 1998). There are rare, but anadromous populations do occur in the Churchhill, Nelson, and Seal rivers of Manitoba (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). A variety of *S. alpinus*, known as Quebec red trout, was introduced into Upper and Lower Block lakes (1957) and Third Vermillion Lake (1959) in Banff National Park, Alberta, although reproduction is not known to have occurred in these waters (Nelson and Paetz 1992).

Arctic char occur as either anadromous or landlocked populations. They are also known to occur as stunted populations that may or may not co-exist with normal-sized char in inland lakes (Bradbury *et al.* 1999). Very little regionally specific information is available for the Arctic char in northern Manitoba. In general, anadromous Arctic char usually spawn in autumn around September or October, during the day over gravel or rocky shoals in lakes or quiet pools in rivers, at depths of 1 to 4.5 m, and at temperatures around 4°C (Bradbury *et al.* 1999). Females spawn every second or third year and the eggs develop over winter in temperatures between 0 and 2.2°C. The females dig a redd in loose substrate and the eggs incubate buried in the gravel and cobble (Scott and Crossman 1998; Bradbury *et al.* 1999). The eggs are killed at temperatures above 7.8°C. Hatching occurs in April and the fry emerge from the gravel after ice out in mid-July. In anadromous populations, juveniles migrate to ocean habitats when 15 to 20 cm long (Scott and Crossman 1998), and last from one to four months with the fish returning in the fall to overwinter in lakes (Bradbury *et al.* 1999). The age at which they first migrate ranges from 1 to 5 across their geographic distribution. In the Western Canadian Arctic the first seaward migrations are generally at 3 to 4 years of age (Bradbury *et al.* 1999)

Landlocked populations are reported to mature at the age of 2 to 3 years and usually spawn in streams or lakes from early October to mid-November. Preferred substrates of gravel or cobble are utilized and spawning generally occurs at depths from 1 to 5 m, which is sufficient to keep the eggs safe from winter ice (Bradbury *et al.* 1999). In northern populations a redd is constructed in loose gravel and the eggs incubate at 0 to 2°C (Bradbury *et al.* 1999). The eggs hatch from early April to June and the alevins remain in the gravel until ice break up (Scott and Crossman 1998). YOY leave shore in the summer and occupy sublittoral or profundal habitats as well as pelagic zones. YOY also seek cover in the bottom substrates of cobble, rubble, and boulders. Juveniles are known to change habitats from benthic (>5 metres) to pelagic areas at 3 to 4 years of age (Bradbury *et al.* 1999).

Bull trout (*Salvelinus confluentus*)

Bull trout occur in the Peace River, upper reaches of the Athabasca, North Saskatchewan, Smoky, Red Deer, Bow, and Oldman River drainages in Alberta. The range of this fish has been significantly reduced, particularly in the eastern portions of its range (Nelson and Paetz 1992).

Adfluvial and fluvial populations of bull trout occur in western Canada. Fluvial populations complete their life history entirely in stream habitats. The following habitat summary relates to the adfluvial populations of bull trout. Adult bull trout spend their winters in cold lakes at variable depths, and they migrate to river mouths (e.g., Peace River area) in August to September to spawn in the fall (usually in October). Bull trout in lakes are reported to feed exclusively on forage fish (Meehan and Bjornn 1991). However in Lower Kananaskis Lake, Alberta, *Mysis relicta* form a large part of their diet (Stelfox 1987; Mushens and Post 2000) and in Pinto Lake, bull trout feed almost exclusively on invertebrates. Depth preference in adults is primarily related to temperature, being found in depths of up to and >10 m (Golder 1998b). Bull trout have been reportedly associated with the coldest stream reaches in the watersheds where they occur and temperature is thought to be an important characteristic of suitable habitat (optimal <12°C) (USFWS 1998). This species spawns exclusively in flowing water and has not been reported to spawn in lakes. Spawning is reported to occur in temperatures ranging from approximately 7 to 9°C, and in current velocities ranging from 0.25 to 0.65 m/s (Ford *et al.* 1995; USFWS 1998). Preferred spawning depths in streams are up to 1 m (Ford *et al.* 1995). The spawning habitats are reported as always in streams and rivers with a bottom of medium to large gravel and rubble (Nelson and Paetz 1992) in which the female digs a redd, deposit the eggs, and covers them with the displaced gravel (Nelson and Paetz 1992). The eggs hatch in April and spend approximately eighteen days in the gravel prior to emergence.

The YOY are generally inactive on the bottom substrate at first and then begin to actively feed and grow (Scott and Crossman 1998). The juveniles are found in streams for several months up to four years prior to migrating into lakes and, according to Meehan (1991) and Ford *et al.* (1995), use cobble and boulder substrates for cover. Bull trout are reported to be more strongly tied to substrate than other salmonids, and substrate composition has been correlated with the occurrence and abundance of juveniles (Meehan and Bjornn 1991; USFWS 1998). They are commonly found at depths up to 1 m (Ford *et al.* 1995). Bull trout generally mature at 4 or 5 years of age (Nelson and Paetz 1992; USFWS 1998) but have been found to mature at 5 to 7 years of age in Lower Kananaskis Lake Alberta (Stelfox and Egan 1995; Mushens and Post 2000).

Brook trout (*Salvelinus fontinalis*)

Brook trout have been introduced to the upper reaches of the Peace, Athabasca, North Saskatchewan, Red Deer, Bow, and Oldman River drainages in Alberta (Nelson and Paetz 1992) and lakes and rivers of the Saskatchewan and Winnipegosis drainage basins in Saskatchewan (Atton and Merkowsky 1983). Anadromous populations of this species are also native to northeastern Manitoba in the Nelson, Hayes, Churchill, and Seal river systems (Scott and Crossman 1998). In Saskatchewan they are also found in streams of the Mississippi drainage basin and occasionally inhabit the East End Reservoir when they are washed downstream during high flow events (Ron Jensen August 2001, pers comm. SERM ph [306] 778-8210).

Brook trout occur in clear, shallow, cool, well-oxygenated streams and lakes, and seek out temperatures below 20°C, optimally between 13 and 16°C and on average a dissolved oxygen concentration of 8 mg/L (Ford *et al.* 1995; Bradbury *et al.* 1999). Temperatures >27°C are lethal. Summer temperatures that heat up lakes and streams will cause this trout species to relocate to cooler depths (5 to 9 m) or move from warming streams into larger bodies of water (Scott and Crossman 1998). For optimal resting and feeding habitat the depth should be >0.15 m and have a focal point velocity of <15 cm/s. Brook trout have a high affinity for rock, rubble, gravel, sand (Lane *et al.* 1996c) and uncommonly silt substrates. They associate with undercut banks and emergent vegetation cover, and prefer depths <0.70 m in streams (Raleigh 1982; Ford *et al.* 1995).

The age at maturity of brook trout is 2 or 3 years and they spawn in late summer or autumn (September to November) depending on temperature and latitude (Ford *et al.* 1995; Scott and Crossman 1998). The preferred temperature for brook trout spawning is approximately 9°C and spawning occurs at depths up to 2 m (Nelson and Paetz 1992) and on occasion 2 to 10 m (Ford *et al.* 1995). The mature fish may travel many kilometres upstream to spawn on gravel shallows of headwater streams with good groundwater inflow (Nelson and Paetz 1992). They are reported to spawn in gravel shallows of lakes where there are spring upwellings and a moderate current (Meehan and Bjornn 1991; Scott and Crossman 1998). They are also reported to spawn on sandy, heavily silted substrates, as well as organic material, provided sufficient upwelling of groundwater is present (Bradbury *et al.* 1999). Silt and debris/muck is cleared away in the area and the eggs are lodged within a gravel nest and covered with gravel (Scott and Crossman 1998).

Brook trout eggs incubate over winter within the gravel. The optimal oxygen levels for incubation should be above 8.8 mg/L and the pH about 6.5. If the temperature is 5°C, 6.1°C, or 10°C, eggs hatch in 100 days, 75 days, or 50 days, respectively (Scott and Crossman 1998). The larval fish stay in the gravel from approximately December to March and emerge in 27 to 56 days, between January and April (Ford *et al.* 1995). They then inhabit depths of up to 5 m (Meehan and Bjornn 1991; Nelson and Paetz 1992) and occasionally between 5 and 10 m (Bradbury *et al.* 1999). Emerged YOY opt for larger substrate areas of boulder, gravel, cobble, and rubble (Raleigh 1982; Bradbury *et al.* 1999). They are almost always associated with emergent, submergent and in-situ cover (Raleigh 1982; Bradbury *et al.* 1999).

The substrate and cover that brook trout juveniles frequent are the same as the YOY (Ford *et al.* 1995; Bradbury *et al.* 1999). They do, however, have occasional preference for the pelagic zone. The juveniles move to shallow areas of stream or lakes margins, nearly always <5 m deep (Nelson and Paetz 1992; Ford *et al.* 1995); however, they have been reported to occur in depths >5 m (Bradbury *et al.* 1999). Brook trout then migrate into lakes for one to two years prior to maturation (Ford *et al.* 1995). Their preferred depths and temperature is similar to the adults, approximately 12 to 15°C, with optimal oxygen concentration of >3 mg/L (Ford *et al.* 1995).

Dolly Varden char (*Salvelinus malma*)

Dolly Varden are found in Chester Lake Alberta. They were also introduced, but are no longer present in the Red Deer River system (Red Deer and Panther rivers, and Burnt Timer Creek systems) (Longmore and Stenton 1981), and at the headwaters of the South Saskatchewan River Basin in Alberta (Nelson and Paetz 1992). Nelson and Paetz (1992) refer to a subspecies called the northern Dolly Varden, which is now known as the Dolly Varden char (David Fernet, pers. comm. 2001). The bull trout (*Salvelinus confluentus*) and the Dolly Varden were previously considered to be the same species and are often referred to as the same species despite evidence that shows the two are distinct (Nelson and Paetz 1992).

Very little information exists concerning the single Dolly Varden population found in the prairie region. In Arctic areas, for almost nine months of the year, these fish occupy relatively small reaches of streams and river channels and tributaries to large rivers for overwintering (Longmore and Stenton 1981). The availability of overwintering habitat is reported as critical to their survival (USFWS 2001) and unobstructed migration to feeding areas is important if Dolly Varden are to make the best use of the limited open-water season. After breakup, which begins in late May or early June, the distribution of Dolly Varden expands to streams and river channels that were previously frozen, and to the nearshore waters for feeding and rearing. This species spawns in the fall over bedrock, rubble, and gravel (Meehan and Bjornn 1991; Nelson and Paetz 1992; Scott and Crossman 1998) in water up to 2 m deep (Meehan and Bjornn 1991; Scott and Crossman 1998) with the eggs hatching in the spring (Nelson and Paetz 1992). In Chester Lake, spawning occurs in the lake on a shoal near the base of a scree slope (Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793). YOY use shallow-water up to 2 m deep (Scott and Crossman 1998) over rubble, cobble, gravel, and sand (Skeesick 1989; Scott and Crossman 1998). In anadromous populations, juvenile Dolly Varden remain in rivers for several years. Between the ages of 2 and 4 years, juvenile anadromous char complete their transformation to smolt. The fish then migrate to nearshore coastal waters where they spend the summer months feeding on macroinvertebrates. Juveniles associate with water depths >1 m over cobble and gravel. Adults have similar depth preferences and are nearly always associated with gravel substrate. All age classes associate with in-situ cover.

Dolly Varden maintain a strong fidelity to overwintering and spawning areas in the rivers they return to in late August through September. Overwintering and spawning areas are associated with springs that flow year-round. Dolly Varden generally mature after 5 years (USFWS 2001).

Lake trout (*Salvelinus namaycush*)

Lake trout occur in the Peace, Athabasca, and Beaver River drainages, and in headwater lakes of the Athabasca, and North and South Saskatchewan drainages in Alberta (Nelson and Paetz 1992). This species is also found in lakes and rivers throughout northern Saskatchewan and Manitoba, as far south as Lake Winnipeg and the Winnipeg River in southeastern Manitoba (Scott and Crossman 1998).

All life stages of the lake trout inhabit relatively deep lakes and move into rocky or gravel shoals in preparation for spawning in fall (Machniak 1975c; Meehan and Bjornn 1991; Olver 1991; Nelson and Paetz 1992). After spawning in the lake, the adults disperse throughout the lake at various depths, depending on water temperature. During the winter months they are found at depths of between 2 and 10 m (Johnson 1976). In spring they occur frequently in surface waters after ice breakup, and retreat to the hypolimnion in the warm summer months (Scott and Crossman 1998). This is usually at depths between 14 and 20 m with a preference for water temperatures around 12°C (Marcus *et al.* 1984). Adults generally have no specific substrate or cover preference and are regularly found in the pelagic zone (Ford *et al.* 1995). In far northern waters, adults of this species have been observed to remain in shallower waters during summer months. Sawchyn (1973) observed adult lake trout in Wollaston Lake in waters <10 m deep, over rocky ledges, during the summer. These fish appeared to be responding to temperature and only moved to deeper water during a warm period in August.

Lake trout mature between the ages of 4 to 13 years (Meehan and Bjornn 1991), but usually between 6 and 7 years. Spawning occurs mid-September to October (Nelson and Paetz 1992) at water temperatures of 8.9 to 14°C (Scott and Crossman 1998). They prefer gravel, cobble, and rubble for spawning (Nelson and Paetz 1992; Fitzsimons 1994). Lake trout do not spawn on sand, silt or muck (Machniak 1975c; Golder 1998b). Spawning shoals are often in areas exposed to the prevailing winds where wave action and currents act to keep the rocky substrate free of sand and silt (Bradbury *et al.* 1999). Spawning has commonly been noted at depths <1 m and >10 m (Marcus *et al.* 1984; Meehan and Bjornn 1991; Golder 1998b; Scott and Crossman 1998). More specifically, in the prairies, spawning takes place at preferred depths of 1 to 4.5 m, and around 6.5 m (Machniak 1975c; Fitzsimons 1994). The eggs are fertilized and deposited over the rocky bottom and fall into the crevices between large rocks (Scott and Crossman 1998). The eggs remain in the substrate for four to five months and usually hatch in March or April at temperature of 0.3 to 1.0°C (Scott and Crossman 1998).

Once they have hatched, the fry stay inshore (Ford *et al.* 1995) and within a month of hatching seek deeper water in spring and summer (Scott and Crossman 1998) and have a preference for temperatures between 9 and 10°C (Marcus 1984). Fry have a strong preference for in-situ cover and are usually found over substrates of boulder, cobble, rubble, gravel, and sand (Ford *et al.* 1995; Lane *et al.* 1996b; Golder 1998). The juveniles are similar to adults in that they have variable depth preferences and seek deeper water as the open-water season progresses towards summer (Ford *et al.* 1995). Juveniles prefer boulder, rubble, and cobble substrates and are highly associated with in-situ cover (Ford *et al.* 1995). Both YOY and juveniles are known to occupy sub-optimal habitats (i.e., low oxygen or warmer temperatures than preferred) and seek in-situ cover to avoid predation by larger lake trout (MacLean *et al.* 1990; MacDonald *et al.* 1992).

Arctic grayling (*Thymallus arcticus*)

Arctic grayling occur primarily in cool lakes, streams and drainages in northern Alberta, Saskatchewan, and Manitoba, with some fish being found in central portions of Alberta and Saskatchewan (Atton and Merkowsky 1983; Nelson and Paetz 1992; Scott and Crossman 1998). They range from the west coast of the Hudson Bay to Owl River, Manitoba; south in Saskatchewan to Reindeer Lake (absent from much of the Churchill River); south to central Alberta from the Peace River north; and south-western Alberta in the Belly River (Scott and Crossman 1998). Arctic grayling have been successful introduced to several lakes in Saskatchewan, including Lac la Ronge in north-eastern Saskatchewan (Scott and Crossman 1998) and in Alberta (Bear Pond, Big Iron Lake, Wedge Pond and Quarry Lake) (Dave Borutski

May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793).

The general habitat of Arctic grayling is clear waters of large, cold rivers, rocky creeks, and lakes (Scott and Crossman 1998). Adult Arctic grayling have a high affinity for lake habitat and are found primarily at depths from 2 to 10 m, sometimes frequenting 1 to 2 m depths. They are infrequently found in lakes at <1 m or >10 m depths (Fabricus and Gustafson 1955). They are reported to avoid turbid parts of rivers (e.g., Mackenzie River) but have been regularly captured in this habitat type (David Fernet pers. comm. 2001 ph.[204] 299-5605). Arctic grayling will enter milky, glacial streams or large rivers during freeze-up (Scott and Crossman 1998). Their preferred substrates consist of boulders, rubble and gravel and adults are infrequently found over sand. Arctic grayling are also associated with cover such as in-situ (logs and boulders), submerged, and emerged vegetation (Fabricus and Gustafson 1955; Ford *et al.* 1995). Adult Arctic grayling were captured by gillnet from shallow waters over rocky reefs bordering the main part of Wollaston Lake (Sawchyn 1973).

Arctic grayling are known to spawn in both lakes and streams or rivers, although riverine habitats are thought to be preferred. During ice break-up (April to June), adult grayling (generally 6 to 9 years of age; minimum of 3 years) have been observed to migrate from ice-covered lakes and rivers to spawn in gravel to rocky parts of surrounding tributaries (Scott and Crossman 1998). Spawning substrate preference is reported as gravel/boulder with <20% sand (Ford *et al.* 1995). Arctic grayling are reported to infrequently spawn within lakes, and where it has been reported spawning areas are usually associated with lake inlets, outlets or margins of lakes at depths up to 10 m and rarely >10 m (Fabricus and Gustafson 1955). It is also infrequent that Arctic grayling are found spawning over sand or muck, or near submergent vegetation (Scott and Crossman 1998). The capture of ripe adults near rocky shoals, several kilometres from any inlet or outlet streams in Wollaston confirmed lake spawning for this population (Sawchyn 1973). In Alberta, arctic grayling have successfully reproduced in Big Iron Lake which lacks any inlet or outlet stream and has a predominantly silt covered bottom with some *Chara* (Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793).

The temperatures of spawning habitats are reported to be between 7 and 10°C (Ford *et al.* 1995). The males protect the spawning grounds; however, no actual redd or nest is prepared and most spawning occurs during the day (Ford *et al.* 1995). The material that has been stirred up during spawning covers the produced eggs. Hatching takes place between eight and 32 days, depending on temperature, with optimal incubation temperatures identified as 6 to 10°C, and they begin to feed three days later (Ford *et al.* 1995; Scott and Crossman 1998).

The YOY are infrequently found in lakes unless they are spawned there. The YOY are frequently found at depths of up to 1 m, and infrequently inhabit areas >1 m deep. Their preferred substrates are boulders, rubble, and gravel, and they are infrequently associated with sand and silt substrates. The YOY also have a high affinity for in-situ cover (Fabricus and Gustafson 1955). Juveniles are found at the same depths as adults; however, their preferred substrates and cover habitat are nearly always an area with boulders, cobble, gravel, sand and in-situ cover (Fabricus and Gustafson 1955). In Wollaston Lake, YOY and juveniles were captured by seining shallow, relatively sandy shoreline habitats (Sawchyn 1973).

Trout-perch (Percopsidae)

Trout-perch (*Percopsis omiscomaycus*)

Trout-perch are commonly found in lakes and streams throughout Alberta (excluding waters in the Rocky Mountains) (Nelson and Paetz 1992), Saskatchewan (Atton and Merkowsky 1983), and Manitoba (Scott and Crossman 1998).

This species occurs in depths ranging up to and >10 m (Lane *et al.* 1996c) and inhabits both lakes and rivers (Nelson and Paetz 1992). In Saskatchewan during summer months, they have been captured by seine haul and electrofishing in waters <2 m, generally over sandy or rocky substrates, but occasionally in areas with submergent vegetation (Sawchyn 1973; SERM - unpublished data 2001). Adults in eastern Canada have been observed to remain off-shore, in deeper waters during the day, and move in-shore at night (Scott and Crossman 1998). Spawning occurs in the spring and has been reported for depths up to and >10 m over substrates of rubble, gravel, sand, and silt-clay, and is generally associated with the presence of in-situ or vegetative cover (Carlander 1969; Lane *et al.* 1996a; Scott and Crossman 1998).

Cod (Gadidae)

Burbot (*Lota lota*)

Burbot occur throughout Manitoba and Saskatchewan and most of Alberta (Scott and Crossman 1998). Burbot do occur in some foothill streams in Alberta but they are rare in the Rocky Mountains, although individuals may occasionally undergo movements into mountain streams (Nelson and Paetz 1992). In central and southern areas, burbot usually reside in the deep areas of lakes; in northern areas, this species can be found in large, cool rivers (Scott and Crossman 1998) and reservoirs in mountainous areas (McPhail 1997). Burbot are described as a coldwater species (Boag 1989).

Burbot spawning temperatures are reported to be between 1 and 4°C in water <2 m deep, under the ice in winter or early spring (specifically in February and March in Alberta) (Nelson and Paetz 1992). When they spawn in lakes, the locations are near-shore shallows or over shallow offshore reefs and shoals. The spawning substrates are generally sand, gravel, or cobble but free of silt (McPhail 1997). In rivers, spawning occurs in low velocity main and side channels behind depositional bars, where the substrates are fine gravel, sand, or even fine silt (McPhail 1997). Northern adult populations in areas such as Lake Winnipeg in Manitoba and Cold Lake, and Lac Sainte Anne in Alberta are known to skip spawning some years (McPhail 1997). The eggs are deposited on top of the substrate but are not adhesive and tend to drift until they become lodged in the substrate (McPhail 1997).

Larval habitat is reported as the pelagic zone in the spring where they drift until their swimming capabilities improve and then move inshore to feed in early summer (McPhail 1997). This depth is usually between 3.0 and 7.5 m in quiet waters. In August, the YOY become nocturnally active benthic feeders (McPhail 1997) and in the fall inhabit a depth between 5 and 10 m. YOY are also known to seek shelter under stones, debris, weed beds, and cutbanks during the day in shallow bays, and along rocky shores (Scott and Crossman 1998).

Juveniles in lakes in the Qu'Appelle River system in Saskatchewan were observed in association with rocky substrate in either vegetated or non-vegetated areas (SERM - unpublished data 2001). Mature burbot (>4 to 7 years of age) that reside in lakes tend to inhabit areas below the thermocline and on the bottom, between temperatures of 10 to 12°C and build burrows in the deep-water substrate (McPhail 1997). The adults also inhabit northern turbid rivers with temperatures that rarely exceed 18°C in the summer (McPhail 1997). The adults can be found over rocky substrate in predominately non-vegetated areas in the Qu'Appelle drainage system in Saskatchewan (SERM - unpublished data 2001).

Stickleback (Gasterosteidae)

Brook stickleback (*Culaea inconstans*)

Brook stickleback are found in small streams, lakes, ponds, and bogs throughout Alberta including the Hay, Slave, Peace, Athabasca, North Saskatchewan, Beaver, Red Deer, Bow, Oldman, South Saskatchewan, and Milk River drainages. They are also located in the central and southern Saskatchewan, including the Churchill River drainage, and most of Manitoba, excluding waters north of Seal River (Atton and Merkowsky 1983; Nelson and Paetz 1992; Scott and Crossman 1998).

Their preferred habitats are small streams, springs, bogs, or lakes where aquatic vegetation and debris are found (Nelson and Paetz 1992). They are also found in waters with low oxygen content where other fish species could not survive (Nelson and Paetz 1992). Adults occur close to, or within, aquatic vegetation and frequent areas with in-situ vegetation (SERM - unpublished data 2001). They have a high affinity for substrates consisting of silt, clay, sand, and gravel and also commonly occur over cobble and rubble substrates (SERM - unpublished data 2001). In the summer, adults are found in depths of <2 m, whereas throughout the rest of the year they are found throughout the entire water column (Lane *et al.* 1996c).

Sexual maturity occurs in the second growing season and spawning takes place in May and June at a minimum of 8°C. Spawning habitat consists of submergent or emergent vegetation and overhead cover (Nelson and Paetz 1992; Lane *et al.* 1996a). As a result, spawning may be associated with a wide variety of substrates including sand and silt-clay, and less frequently gravel (Lane *et al.* 1996a). Brook stickleback construct nests at depths <1 m by the males and consist of bits of plants, algae, leaves, roots and debris with two openings. The eggs are then laid inside the cavity (Brown 1971). The nests are built on rooted aquatic plats or submerged tree branches (Nelson and Paetz 1992). The eggs hatch when temperatures reach 16 to 18.3°C in approximately eight to nine days and are protected by the male until the YOY are capable of swimming (approximately two weeks). All life stages are commonly found in lakes. In the spring, YOY prefer depths <2 m and in the fall <2 to 10 m (Lane *et al.* 1996b). The YOY prefer areas with submergent vegetation to provide cover (Lane *et al.* 1996b; SERM –unpublished data 2001).

Threespine stickleback (*Gasterosteus aculeatus*)

Threespine stickleback are found along the coast of the Hudson Bay and may occur in inland lakes and rivers in northeastern Manitoba (Scott and Crossman 1998). In Alberta, threespine stickleback are found only in Hasse Lake, where these fish were introduced illegally in the late 1970s (Nelson and Paetz 1998). In coastal areas of Manitoba, both anadromous and freshwater resident populations occur; however, only one freshwater resident population, inhabiting river habitat, has been confirmed (Ken Steward pers. comm. University of Manitoba retired ph. [204] 269-3997).

Spawning by freshwater resident populations of this species takes place in lakes, usually in mid-summer (Scott and Crossman 1998). Spawning is reported as occurring in two distinct habitat types; open areas, or in areas associated with aquatic vegetation (Bradbury *et al.* 1999). The males build nests near aquatic vegetation and the nest are generally in more exposed locations than is observed for other stickleback species (Bradbury *et al.* 1999). Threespine stickleback generally avoid spawning in areas <0.2 m deep and are reported to construct nests at depths up to 40 m (Bradbury *et al.* 1999). The nest consists of small twigs, algae, and plant debris over a sandy or mud bottom (Scott and Crossman 1998). Other substrates that this species has been found to nest on include silt, algal tufts, and rock and the nests are built close to in-situ cover of boulders, rocks, and vegetation (Bradbury *et al.* 1999). The eggs are deposited on the nest and are guarded by the males. Once hatching occurs, the fry are also guarded by the males for approximately two weeks. All life stages of threespine stickleback are found in littoral areas of lakes with well-developed macrophyte beds and rocky or mucky substrates (Bradbury *et al.* 1999). They can also be found in the pelagic zone at times and are known to occur at depths up to 17 m (Bradbury *et al.* 1999). Juveniles and adults overwinter in deeper water of lakes (Bradbury *et al.* 1999).

Ninespine stickleback (*Pungitius pungitius*)

Ninespine stickleback are found in the Hay, Slave, Peace, Athabasca (lower reaches only), and Beaver River drainages in Alberta. These fish occur throughout Saskatchewan in all of the major river drainages except for the Missouri and Souris drainages (Atton and Merkowsky 1983), and throughout Manitoba (Scott and Crossman 1998). All ninespine stickleback life stages prefer lakes. In Alberta they only occur in their deep cold lakes and their tributaries (Nelson and Paetz 1992).

Spawning takes place in the summer in shallow areas containing dense aquatic vegetation and occasionally in areas with no cover (Bradbury *et al.* 1999). The nests are constructed at depths of <1 m, generally positioned on aquatic vegetation, and located in areas with a wide range of substrates (Lane *et al.* 1996a; Bradbury *et al.* 1999). They spawn infrequently at depths >1 m (Lane *et al.* 1996a). The eggs are deposited in the nest and are guarded by the males. The male continues to guard the young for approximately two weeks after hatching. Following this period the fry are found in the shallow littoral zone. The YOY migrate to open-water areas of lakes in the fall where all life stages are found (Bradbury *et al.* 1999). In the spring the young are found at depths <2 m (Lane *et al.* 1996b) and in the fall frequently between 2 and 5 m (Lane *et al.* 1996b). Substrates for the YOY are generally reported as muck, clay, rubble, and occasionally sand (Lane *et al.* 1996b; Bradbury *et al.* 1999). The YOY are usually associated with aquatic vegetation.

Juveniles and adults have very similar habitat preferences and are concentrated in areas <2 m deep in the summer. Throughout the rest of the year they are found in various location in lakes (Nelson and Paetz 1992; Lane *et al.* 1996c; Bradbury *et al.* 1999). Substrate associations have been observed to be rubble, sand, silt, clay and occasionally gravel (SERM- unpublished data 2001). This species has no strong preference for cover and is observed in open areas as well as areas with submergent and emergent vegetation (SERM -unpublished data 2001). Adults are frequently pelagic, tending to school in deeper zones, and do not have a high affinity for rooted aquatic plants (Nelson and Paetz 1992).

Sculpins (Cottidae)

Mottled sculpin (*Cottus bairdi*)

Mottled sculpin are found in southern Manitoba, including Lake Winnipeg and its tributaries and as far north as the Mukatawa River, as well as the Milk River system of southern Alberta (Scott and Crossman 1998).

Their primary habitat is reported as cool streams and lakes, but not usually deep lakes or headwater streams (Bradbury *et al.* 1999). The preferred substrate for mottled sculpin is sand in both lakes and streams (Bradbury *et al.* 1999). They are intolerant of high water temperatures and will reside in areas with an average summer water temperature of approximately 17°C (Bradbury *et al.* 1999).

Mottled sculpin mature at 3 years of age (Scott and Crossman 1998) and spawn in the spring (April to mid-May) in the littoral zone (<1 m) of lakes under rocks and logs (Bradbury *et al.* 1999). The adhesive eggs are deposited on the ceiling of a rock, ledge, or burrowed nesting site where the male guards and aerates them (Bradbury *et al.* 1999). The YOY inhabit mud bottoms in July (Scott and Crossman 1998) at depths of 5 to 25 cm. Juveniles are largely associated with cover, and are generally located under rocks and logs in the littoral zone of lakes during the summer through to the fall (Bradbury *et al.* 1999).

Slimy sculpin (*Cottus cognatus*)

Slimy sculpin are found throughout Alberta, most of Saskatchewan, and Manitoba (Scott and Crossman 1998). This species is absent from Qu'Appelle and Missouri River drainages in

Saskatchewan (Atton and Merkowsky 1983) and waters south and west of the Athabasca River (Petiot, Peace, Hay, Slave and Beaver River drainages) in Alberta (Nelson and Paetz 1992).

Slimy sculpin have a high affinity for deep lakes but are present in cool rocky streams as well. They usually occur between and under rocks, at depths of 1 to 5 m in the spring and fall, and >5 m in lakes during the summer months (Nelson and Paetz 1992; Lane *et al.* 1996c). They are most frequently found associated with rubble, gravel, and sand substrates and occasionally are encountered in boulder, cobble, silt and clay areas (Lane *et al.* 1996c). Slimy sculpin are also almost always associated with in-situ cover (Nelson and Paetz 1992).

Adult slimy sculpin mature at approximately 3 years of age (Scott and Crossman 1998) and move to shallow waters of lakes and cooler streams where temperatures are optimally 5 to 10°C to spawn (Scott and Crossman 1998). Spawning activity occurs in May and June in lakes at depths up to 2 m and sometimes up to 5 m. The slimy sculpin have a high affinity for spawning areas with substrate that consists of boulder, rubble, cobble, gravel and a lesser affinity for silt and sand substrates (McPhail 1970; Lane *et al.* 1996a; Golder 1998a; Bradbury *et al.* 1999). Cover in spawning areas may also consist of in-situ vegetation. The eggs are fertilized under large rocks or logs (Scott and Crossman 1998). The YOY and juveniles both utilize similar habitats and have only been observed in depths up to 2 m (Scott and Crossman 1998). They are also associated primarily with substrates that consists of boulder, rubble, cobble, hard-pan clay (occasionally over gravel and sand) with in-situ vegetative cover (Lane *et al.* 1996b,c; Bradbury *et al.* 1999).

Spoonhead sculpin (*Cottus ricei*)

In Alberta, spoonhead sculpin are found primarily in the foothills, but these fish do occur in the Slave, Peace, Athabasca, North Saskatchewan, upper Red Deer, Bow, and upper Oldman River drainages (Nelson and Paetz 1992). This species is known to occur in the South Saskatchewan River system and Lake Athabasca and Wollaston Lake in Saskatchewan (Atton and Merkowsky 1983; Scott and Crossman 1998). In Manitoba, spoonhead sculpin are found from a few locations in the Lake Winnipeg region, in the Saskatchewan, Hayes, and Churchill rivers, and Neultin Lake (Scott and Crossman 1998; Ken Stewart, pers. com. 2001). Spawning is thought to occur in the summer or fall and is associated with substrates ranging from bedrock to gravel, at depths from 2 to >10 m (Lane *et al.* 1996a). YOY and adults utilize a wide range of substrates and depths (Lane *et al.* 1996b).

Deepwater sculpin (*Myoxocephalus thompsoni)*

Deepwater sculpin are found only in Waterton Lake in southwestern Alberta (Nelson and Paetz 1992), in Reindeer, Mirond, MacKay, La Ronge, La Plonge, and Wollaston lakes in northern Saskatchewan (Atton and Merkowsky 1983; Nelson and Paetz 1992), and in West Hawk Lake and Lake Athapapuskow in Manitoba (Scott and Crossman 1998).

Deepwater sculpin spawn late in the summer or early fall. Some evidence suggests year-round spawning in the Great Lakes; however, not much is known because of the great depths they inhabit (Scott and Crossman 1998). It is hypothesized in a Lake Michigan study (Mansfield *et al.* 1983) that spawning occurs in late October to January near the substrate, where the adults dwell year-round. The eggs are assumed to have an incubation period of approximately 97 days at 1.5°C and are guarded in nests on the substrate (Mansfield *et al.* 1983). Deepwater sculpin fry have been identified in early February and were common in the months of March and April (Mansfield *et al.* 1983). In May, YOY deepwater sculpin are found pelagically or in near-shore waters at depths of 0.5 to 17 m, and at temperatures below 6°C. YOY are also known to inhabit any stratum, whereas the adults remain on the bottom (Mansfield *et al.* 1983) .

Sunfish (Centrarchidae)

Rock bass (*Ambloplites rupestris*)

Rock bass occur in the Assiniboine and Qu'Appelle River in south-eastern Saskatchewan and Manitoba, and in the Red River and Winnipeg River systems to Lake Winnipeg in Manitoba (Atton and Merkowsky 1983; Scott and Crossman 1998).

The habitat of the rock bass is the shallow-water of lakes, and the lower, warm reaches of streams (Scott and Crossman 1998). They are found year-round in areas <2 m deep (Lane *et al.*

1996c). The substrates this species prefers are generally cobble, rubble, gravel and less frequently sand silt and clay (Lane *et al.* 1996c). They also strongly prefer the cover of rocks and logs (Scott and Crossman 1998).

When rock bass are mature, the adults move to shallow warm-water habitats, including and gravel shoals, in late spring and early summer to spawn. Here the male builds a nest and spawning commences when water temperatures are between 15.6 and 21.1°C (Scott and Crossman 1998). The eggs are adhesive and are deposited in the nest (Scott and Crossman 1998). In three to four days, the fry emerge and are guarded by the male parent for a short period of time. The young are found in the littoral to limnetic zones of lakes (Scott and Crossman 1998).

Pumpkinseed (*Lepomis gibbosus*)

Pumpkinseed are present in the Red and Winnipeg river drainages of southern Manitoba (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). In Alberta, this species has been caught in Lee Lake (1979), in the Oldman River drainage east of Bellevue and is considered to be present there as the result of an illegal introduction (Nelson and Paetz 1992).

The habitat of the pumpkinseed is clear, warm, and shallow small lakes, ponds, and vegetated bays of larger lakes, as well as quiet water of slow-moving streams. They usually inhabit locations near or at the surface exposed to the sun (Scott and Crossman 1998) and are found year-round at depths <2 m (Lane *et al.* 1996c). The species has a high affinity for gravel and sand substrates and occasionally clay (Lane *et al.* 1996c) with the cover of submergent vegetation or brush (Lane *et al.* 1996c). The preferred temperature of the pumpkinseed is between 18 and 24°C.

Sexual maturity is reached at the ages 2 to 5 years for females (Scott and Crossman 1998). In late spring to early summer, the adults move to a depth of 15 to 30 cm in shallow-water ponds, lakes, or slow-moving streams near shore, and among submergent and emergent vegetation. The substrates of spawning sites can be clay to sand, gravel, or rock with exposed roots used for egg attachment (Scott and Crossman 1998). Here the male builds a nest made of exposed roots of emergent vegetation and when the temperatures reach 20°C, spawning commences (Scott and Crossman 1998). The eggs are adhesive and are laid on the bottom of the nest (Scott and Crossman 1998). The fry emerge in approximately three days at 28°C and are guarded by the male parent for eleven days within the nest area (Scott and Crossman 1998).

Smallmouth bass (*Micropterus dolomieu*)

In Alberta bass were unsuccessfully introduced into Lake Minniwanka and Sylvan, Gull, Pine, Buffalo and Cooking lakes in 1908, and into Ministik Lake in 1924. Between 1977 and 1984 smallmouth bass were introduced into Island Lake, Alberta where some reproduction has occurred (Nelson and Paetz 1992; Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793). In Saskatchewan this species has been introduced to: Harley Pond, near Estevan; Parkbeg Reservior, near Moose Jaw; Chopper Lake, in the Cub Hills; and, in Konoto Lake near Creighton (Murray Koob, SERM pers. com. ph. [306] 953-2885). In Manitoba, smallmouth bass have also been introduced and occur in the Winnipeg River, the southern end of Lake Winnipeg, Dauphin Lake, and Lake Athapapuskow (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

Smallmouth bass are associated with rocky and sandy regions of shallow areas of lakes and rivers (Scott and Crossman 1998). They are found throughout the water column; however, their occurrence varies with the season. In the winter, they are inactive and near the bottom. In the spring they occupy spawning areas and shallows. In the heat of the summer, they move to the deeper zones of the lake where the water is cooler (Scott and Crossman 1998). They are also highly associated with the cover of rocks and logs (Scott and Crossman 1998). In contrast to the largemouth bass, smallmouth are not often found in amongst dense vegetation and they prefer lower temperatures of about 20°C (Lane *et al.* 1996c).

Sexual maturity is reached at the ages of 3 to 5 years for males and 4 to 6 years for females (Scott and Crossman 1998). In late spring to mid-summer, at water temperatures between 12 and 20°C, the adult males move into the spawning areas and begin building nests. The females do not deposit eggs until the water temperature is between 16 and 18°C. The nests are at depths between 1 and 6 m, and generally on sand, gravel, and rock bottom substrates. Nests are usually associated with in-situ cover of rocks, logs and, less frequently, dense vegetation (Scott and Crossman 1998). The male guards the eggs and alevins, which emerge within four to ten days of spawning (Scott and Crossman 1998).

Largemouth bass (*Micropterus salmoides*)

In Alberta bass were unsuccessfully introduced in 1908 into Lake Minniwanka and into Sylvan, Gull, Pine, Buffalo and Cooking lakes, and in 1924 into Ministik Lake. Several years later, largemouth bass were unsuccessfully introduced into Pigeon and Wabamun lakes and Lac La Nonne in the Edmonton area (Nelson and Paetz 1992; Dave Borutski May 2001, pers. comm. Fish and Wildlife Management Section, Alberta Environment ph. [780] 427-7793). In Saskatchewan, largemouth bass are also reported to occur as a result of introductions in Boundary Reservoir on the Souris River (Atton and Merkowsky 1983; Ron Jensen August 2001, pers comm. SERM ph [306] 778-8210). Largemouth bass were introduced into Fort Whyte Nature Centre and Lake Minnewasta as well as Lake of the Woods in south-eastern Manitoba (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

The habitat of the largemouth bass is the upper levels of the warm water found in small, shallow lakes, shallow bays of larger lakes, and rarely, large slow rivers. It is rare to find this species below 7 m of depth (Scott and Crossman 1998) but they are found year-round at depths of <5 m (Lane *et al.* 1996c). This species is known to associate with soft, silt substrates (Lane *et al.* 1996c) and with in-situ cover such as stumps or abundant emergent and submergent vegetation (e.g., pondweed, lilies and cattails) (Scott and Crossman 1998). Largemouth bass are rarely found in lakes with rocky bottom substrates (Scott and Crossman 1998). The preferred temperature of the largemouth bass is between 26.6 and 27.7°C. Largemouth are commonly found inactive in the shade of aquatic vegetation near shore when temperatures are high in August (Scott and Crossman 1998). They move to the lake bottom in the winter and are more active during this period, but temperatures must be above 10°C for them to feed (Scott and Crossman 1998).

Sexual maturity is reached at the ages of 3 or 4 years for males and 4 to 5 years for females (Scott and Crossman 1998). In late spring to mid-summer, the adult largemouth bass move to a depth of approximately 1 m, in the warm water of protected bays. They select areas among emergent vegetation over gravel sand to marl and soft mud in reeds, bullrushes, or water lilies which they uses as nesting habitats (Scott and Crossman 1998). Here the male builds a nest made of exposed roots of emergent vegetation and spawning commences when the temperatures are between 6.7 to 18.3°C (Scott and Crossman 1998). The eggs are adhesive and are laid on the bottom of the nest (Scott and Crossman 1998). In three to five days, the fry emerge and remain the nest for six or seven days, rise, then begin schooling and are guarded by the male parent (Scott and Crossman 1998).

Black crappie (*Pomoxis nigromaculatus*)

The black crappie occurs only in the Winnipeg and Red River systems, and Lake Winnipeg in southern Manitoba (Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997). They favour the relatively large clear, quiet, warm water of ponds, streams, lakes, and reservoirs (Brown 1971). They can also be found in some small lakes, bays, or shallower areas in larger lakes, and areas in large rivers with low velocities. They prefer abundant growth of aquatic vegetation, sandy to mucky bottoms, and are less often found in turbid conditions (Scott and Crossman 1998).

The black crappie species becomes sexually mature at the age of 2 or 3 years and spawning begins in May to mid-July when water temperature is 14 to 18°C (Brown 1971). The nests are generally created by clearing sand, gravel, or mud from an area with some vegetation for the egg masses to rest on or adhere to (Pearse 1919; Scott and Crossman 1998). The males guard the eggs, which hatch in three to five days. The young are nocturnally active and sometimes active at dawn (Pearse 1919; Scott and Crossman 1998). The crappie descend in to deeper areas of a water body in the fall and during the winter months, and then return to shallow-water in the spring where they remain throughout the summer near the surface of the water body (Pearse 1919).

Perch (Percidae)

Iowa darter (*Etheostoma exile*)

Iowa darter occur throughout southern Manitoba, central and southern Saskatchewan in the Churchill River and the North and South Saskatchewan River systems, Qu'Appelle Valley, Antler River, and Cypress Hills area rivers (Scott and Crossman 1998). In southern Alberta they range from the Cypress Hills region and Milk River to the North Saskatchewan River (Nelson and Paetz 1992).

This species prefers clear slow-moving water, and can be found in shallow-water around aquatic vegetation in lakes and streams (Nelson and Paetz 1992). Iowa darter is reported to occur at depths up to 10 m and spends most of the time on the bottom where the substrates consist of organic debris, sand, and peat with rooted aquatic vegetation cover (Lane *et al.* 1996c; Scott and Crossman 1998). They are tolerant of cooler waters but intolerant of turbid, muddy waters with low visibility (Scott and Crossman 1998).

Spawning occurs in the spring and early summer (Nelson and Paetz 1992) when adults move from the deeper waters of lakes to the shallows near shore (Scott and Crossman 1998). Eggs are attached within crevices of stony substrate (Nelson and Paetz 1992), or on fibrous-root material of undercut mudbanks, usually in the shallow-water of lakes, and pond-like expansions in rivers at depths <0.5 m (Scott and Crossman 1998). As such, spawning occurs in association with a wide variety of substrates ranging from rubble to clay (Lane *et al.* 1996a). Hatching occurs in approximately ten days at temperatures between 13 and 16°C (Scott and Crossman 1998). The YOY generally inhabit areas <5 m deep, with gravel, sand or silt substrates, and often associated with submergent vegetation (Lane *et al.* 1996b).

Johnny darter (*Etheostoma nigrum*)

Johnny darter is found from the Souris River to Reindeer Lake of the Churchill River drainage in eastern Saskatchewan (Atton and Merkowsky 1983; Scott and Crossman 1998), and throughout Manitoba north to the Churchill River and Southern Indian Lake (Scott and Crossman 1998). There are no verifiable references to its presence in Alberta (Nelson and Paetz 1992).

Johnny darter is most common in moderate to no current waters, with sand, sand and gravel, or sand and silt bottom substrates. They also inhabit areas with aquatic vegetation and gravel riffles of streams. They are usually associated with inshore waters but have also been found in areas >10 m deep (Lane *et al.* 1996c; Carlander 1997; Scott and Crossman 1998).

Spawning occurs in the spring (May) in the southern range and possibly later (June) for more northern parts of the Prairies (Scott and Crossman 1998). The undersides of rocks are the chosen areas for this species' nesting site. After the eggs are fertilized, the female leaves the site and the males guard the nest, keeping them free of silt and oxygenated (Scott and Crossman 1998). Hatching occurs in five to eight days at temperatures of 22 to 24°C (Scott and Crossman 1998). YOY are generally found in areas <5 m deep, with gravel, sand, or silt substrates, and often associated with aquatic vegetation (Lane *et al.* 1996b).

Yellow perch (*Perca flavescens*)

Yellow perch are found throughout Alberta, excluding the Hay River drainage, the Rocky Mountains and surrounding foothills, and the Milk River drainage (Nelson and Paetz 1992). In Saskatchewan and Manitoba, this species occurs in every major river drainage except for lakes and streams along the Hudson Bay coast in northeastern Manitoba (Atton and Merkowsky 1983; Scott and Crossman 1998).

The yellow perch can inhabit a variety of warm to cooler habitats from large lakes to ponds, or slow-moving rivers (Nelson and Paetz 1992). There is a high affinity for lakes by all life stages (Nelson and Paetz 1992; Lane *et al.* 1996a,b,c). This species has a higher abundance in the open water of lakes with moderate vegetation cover in clear water and bottoms with muck to sand and gravel substrates (Scott and Crossman 1998). Their temperature preference is between 21 and 24°C and they are considered to be a shallow-water species inhabiting depths of <10.5 m (Scott and Crossman 1998).

Spawning is usually in the spring (May) and occurs in waters <10 m deep, at a water temperature of 6.7 to 12.2°C. They have a strong preference for submergent vegetation (Webber 1982; Krieger *et al.* 1983) as well as emergent vegetation and in-situ cover (Webber 1982; Lane *et al.* 1996a; SERM - unpublished data 2001). Spawning on submergent vegetation and fallen branches in lakes is common (Carlander 1997) and the eggs are laid in large adhesive masses, which adhere to the vegetation or debris. The presence of vegetation and debris for spawning are more important than substrate for this species. As such, a wide range of substrates are reported for spawning areas including rubble, gravel, sand, and silt-clay (Webber 1982; Krieger 1983; Lane *et al.* 1996a; SERM - unpublished data 2001).

Once hatching occurs, YOY are at first pelagic (Scott and Crossman 1998) and are nearly always found in waters <5 m deep in the spring. By the fall the are found at depths of 5 to 10 m. Their preferred substrates are gravel, sand, and silt-clay and they are frequently associated with aquatic vegetation. Juveniles have been found over a wide range of substrates including rubble, cobble, gravel, sand, silt, and clay in depths <10 m (Scott and Crossman 1998; SERM - unpublished data 2001). They have also been found in areas with no cover, with in-situ cover, and with emergent vegetation (SERM - unpublished data 2001). Adults are found year-round throughout the entire water column including depths >10 m (Lane *et al.* 1996c). They have a strong preference for gravel, sand, silt, and clay substrates, and on occasion rubble, and rarely bedrock, boulder, or cobble substrates (Lane *et al.* 1996c; SERM - unpublished data 2001).

Logperch (*Percina caprodes*)

Logperch are found in Cold and Marie lakes in the Beaver River drainage of Alberta (Nelson and Paetz 1992), in the Churchill River drainage of central Saskatchewan (Atton and Merkowsky 1983), and throughout southern Manitoba, north to the Hudson Bay coast (Scott and Crossman 1998).

Logperch inhabit sand, gravel, or rocky beaches in lakes, and larger rivers; sometimes in rather swift water. They tend to stay offshore in water deeper than 1.5 m until spawning (Lane *et al.* 1996c; Scott and Crossman 1998). Logperch spawn in late spring, generally starting in June, at depths of 0.1 to 2 m. They are reported to spawn over a wide range of substrates including boulder and cobble, but prefer rubble, gravel, and sand (Lane *et al.* 1996a). The eggs are deposited in the sand and abandoned by the adults (Scott and Crossman 1998). YOY are reported to occur at depths <2 m during the spring and >5 m in the fall, are generally associated with aquatic vegetation, and prefer gravel and sand substrates (Lane *et al.* 1996b). Adults also associate with aquatic vegetation and show a preference for sand and gravel substrates.

Blackside darter (*Percina maculata*)

Blackside darter occur in the Qu'Appelle drainage system and Souris River in southeastern Saskatchewan (Atton and Merkowsky 1983; Scott and Crossman 1998) and in the Winnipeg, Red, and Assiniboine River drainages and tributaries of Swan Lake in Manitoba (Scott and Crossman 1998). The northern-most record for blackside darter is from Big Eddy, near The Pas, Manitoba. This species prefers quiet regions and pools of medium-sized, gravel streams (Scott and Crossman 1998). They prefer clear waters and utilize mid-depths, particularly when young (Scott and Crossman 1998).

Spawning occurs in the months of May or June at temperatures of about 16.5°C. The adults move upstream and the males gather in gravel-bottomed pools or raceways while the females wait in pools or quiet waters downstream. The female then travels upstream to spawn and to choose a suitable sandy or gravel depression to deposit her eggs (Scott and Crossman 1998). The eggs hatch in about six days. Further data on Canadian blackside darter development are generally not available. Lane *et al.* (1996c) reports this species as having a low occurrence in lakes of the Great Lakes Region and preferring boulder, gravel, and sand substrates, in water depths <2 m. Some use of emergent and submergent vegetative cover was also reported by these authors.

River darter (*Percina shumardi*)

River darters are found only in Manitoba, in the Lake Winnipeg drainage area, north to Sipiwesk Lake, and west to Red Deer River and Lake Dauphin (Scott and Crossman 1998).

Their primary habitat is large rivers with rubble or boulder gravel bottoms in a fair to moderate current (Scott and Crossman 1998). They are also rarely found in silty, turbid tributaries and in lakes (Scott and Crossman 1998). They are found year-round in water depths of <5 m and are found associated with a wide range of substrate types (Lane *et al.* 1996c). Spawning is assumed to be in the spring, possibly June or July in Manitoba (Scott and Crossman 1998).

Sauger (*Stizostedion canadense*)

Sauger are found in the North Saskatchewan, Red Deer, Bow, Oldman, South Saskatchewan, and Milk rivers in southern Alberta and are not known to occur in lakes in this province (Nelson and Paetz 1992). In Saskatchewan, this species is found in the Churchill, Saskatchewan, and Qu'Appelle River drainages (Atton and Merkowsky 1983) and throughout southern Manitoba, including Lake Winnipeg (Scott and Crossman 1998).

Sauger prefer large, shallow lakes that are turbid with colloidal clay suspension, or large, turbid, slow-flowing rivers (Scott and Crossman 1998). Adults are generally found above the thermocline and at depths <10 m (Lane *et al.* 1996c). They prefer sand, silt, and clay substrates (Lane *et al.* 1996c).

Spawning has been reported to begin when the water temperatures are between 3.9 and 6.1°C in late April and early May (Nelson 1965). Spawning occurs at night in water up to 4 m deep over sand, gravel, or rubble shoals and shorelines (Auer 1982; Lane *et al.* 1996a; Scott and Crossman 1998). Conflicting reports indicate the eggs are both semi-buoyant and non-adhesive after water hardening, and demersal and adhesive after water hardening (Auer 1982). Hatching occurs 25 to 29 days after fertilisation at 4.5 to 12.8°C. The young spend seven to nine days on the bottom while they absorb their yolk sac (Scott and Crossman 1998). The larvae then inhabit depths of approximately 3.5 m, and are rarely below 7 m in the spawning areas. The YOY are found at a depth <4 m during June and July (Nelson 1965) then move to >5 m depths in the fall (Lane *et al.* 1996b). YOY substrate associations include gravel and sand, and rarely silt (Lane *et al.* 1996b).

Walleye (*Stizostedion vitreum*)

Walleye occur in both lakes and rivers throughout Manitoba, Saskatchewan and Alberta (Scott and Crossman 1998). Although they are relatively common in most Alberta lakes, they are not known to occur in the Rocky Mountains and adjacent foothills (Nelson and Paetz 1992).

Walleye appear to reach their greatest abundance in large, shallow, turbid lakes (Scott and Crossman 1998). Large streams or rivers, providing they are deep or turbid, provide suitable habitat as well. Sunken trees, boulder shoals, submerged vegetation, turbidity, and thick layers ice may all act as overhead cover and shield walleye from bright sunlight. Because of their sensitivity to light, the adults are rarely found in the pelagic zone during the day (Marshall 1977; McMahon *et al.* 1984). Also, if a lake is clear, walleye of all ages can be found in contact with the bottom substrate under cover during the day (Marshall 1977; McMahon *et al.* 1984). Generally, during May and June in the Qu'Appelle Lake system adults were found in shoreline habitats consisting of non-vegetated areas with sand and rock substrate (SERM - unpublished data 2001). According to Johnson *et al.* (1977), the adults in summer are found over silt and muck substrates.

Spawning begins shortly after ice break-up in a lake, at water temperatures of 4.4 to 14.4°C (Marshall 1977). In Lac La Ronge, Saskatchewan, spawning occurred from the end of April to the third week in May (Rawson 1957). The spawning areas are often rocky areas in white water below impassable falls and dams in rivers, or boulder, to coarse-gravel shoals of lakes (Scott and Crossman 1998). The habitat for developing eggs is provided by crevices in the substrate. Within the Mississippi, spawning has been associated with mats of vegetation in flood-bench marshes over silt, clay, detritus and hard-pan clay substrates where adequate flow is present to aerate the eggs (Pitlo 1992); however, this has not been reported for the Prairie region. After twelve to eighteen days the young hatch and are found in open water at depths up to 5 m and frequenting in low flow, shallow embayments of lakes and large rivers (Holland and Huston 1985; Leis and Fox 1996). Leis and Fox (1996) found the presence of YOY associated strongly with the presence of prey, independent of cover or substrate, in near-shore habitats of <2 m. In the fall, YOY are found in waters of 5 to 10 m (Colby *et al.* 1979). Adults and juveniles prefer depths up to 5 m in littoral areas year-round (Wilson 1997), with a high occurrence in the summer at depths of 5 to 10 m (Colby *et al.* 1979). Movements into shallow waters are generally associated with diel changes in light intensity or with turbid conditions (Marshall 1977).

Drum (Scaenidae)

Freshwater drum (*Aplodinotus grunniens*)

Freshwater drum is found only in the Hudson Bay drainage of Manitoba, including the Assiniboine and Red rivers, Lake Winnipeg, Lake Manitoba, and the Nelson River in the north (Scott and Crossman 1998; Dr. Ken Stewart February 2001, pers. comm. University of Manitoba retired ph. [204] 269-3997).

The freshwater drum reside in large, shallow bodies of water with a preference for clear water but is adaptable to high turbidity. Little is known about depth preference but evidence suggests that it lives in the shallow areas, but may be found at depths of 14 to 21 m (Scott and Crossman 1998). This species is adapted to bottom feeding as adults (Scott and Crossman 1998).

Data on the freshwater drum's spawning habitat are limited; however, spawning is thought to occur in July but has been observed in September as well. Habitat for spawning sites is reported to be in bays, lower portions of rivers, and in open lakes. Spawning areas are thought to consist of sand and mud substrates, and depths of <2 m (Scott and Crossman 1998). The eggs are buoyant and float to the surface where the eggs hatch in 25 to 30 hours at a water temperature of 22°C (Scott and Crossman 1998).

Summary and recommendations

It is evident that information on specific lake habitat use is not available for many freshwater species present in Alberta, Saskatchewan, and Manitoba. In order to better manage fish and fish habitat resources, there is a need to acquire further information and future research aimed at minimising the data gaps would be beneficial. However, in the interim, it is believed that the information contained in this report will assist in identifying the lake habitat requirements of fish in Manitoba, Saskatchewan, and Alberta.

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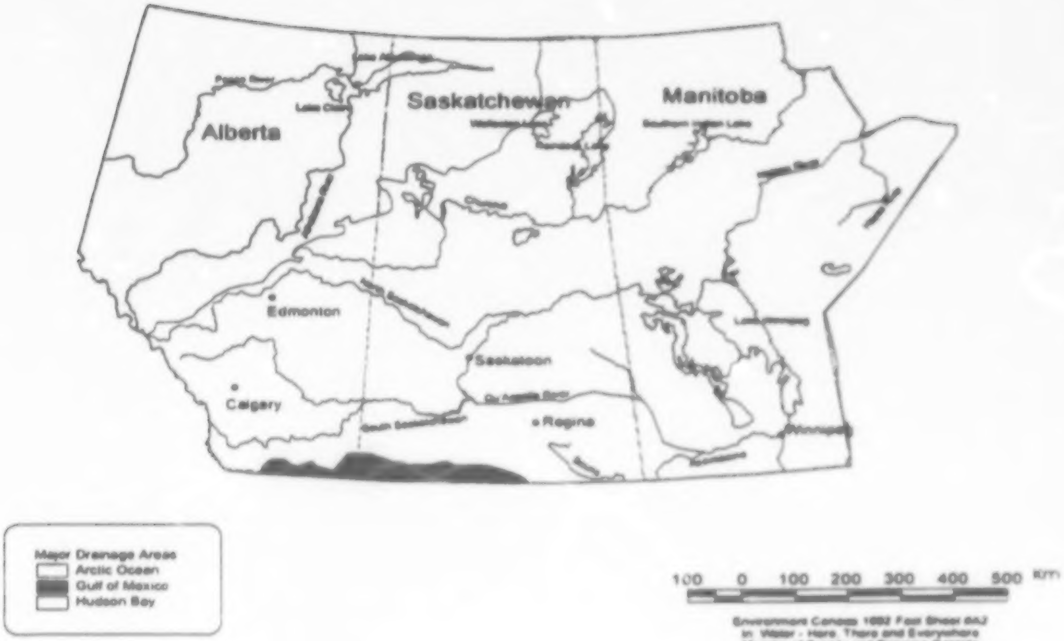
Alberta
Saskatchewan
Manitoba
Edmonton
Calgary
Saskatoon
Regina
Major Drainage Areas
Arctic Ocean
Gulf of Mexico
Hudson Bay
100 0 100 200 300 400 500 km

Environment Canada 1992 Fact Sheet [illegible]
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Figure 1 Major drainage areas in Manitoba, Saskatchewan, and Alberta

Table 1 Species occurring in the freshwaters of Manitoba, Saskatchewan, and Alberta

SCIENTIFIC NAME	COMMON NAME	ALBERTA	SASKATCHEWAN	MANITOBA
Petromyzontidae	**Lamprey**			
Ichthyomyzon castaneus	chestnut lamprey		N	
Ichthyomyzon fossor	northern brook lamprey			N
Ichthyomyzon unicuspis	silver lamprey			N
Acipenseridae	**Sturgeon**			
Acipenser fulvescens	lake sturgeon	N	N	N
Hiodontidae	**Mooneye**			
Hiodon alosoides	goldeye	N	N	N
Hiodon tergisus	mooneye	N	N	N
Umbridae	**Mudminnow**			
Umbra limi	central mudminnow		N	N
Cyprinidae	**Carp and minnow**			
Carassius auratus	goldfish	I		I
Cyprinus carpio	common carp		I	I
Couesius plumbeus	lake chub	N	N	N
Hybognathus argyritis	western silvery minnow	R	N	R
Hybognathus hankinsoni	brassy minnow	N	N	N
Macrhybopsis storeriana	silver chub			N
Margariscus margarita	pearl dace	N	N	N
Nocomis biguttatus	horneyhead chub			R
Notemigonus crysoleucas	golden shiner		N	N
Notropis atherinoides	emerald shiner	N	N	N
Notropis blennius	river shiner	R	R	R
Luxilus cornutus	common shiner		N	N
Notropis dorsalis	bigmouth shiner			R
Notropis heterolepis	blacknose shiner		N	N
Notropis heterodon	blackchin shiner			N
Notropis hudsonius	spottail shiner	N	N	N
Notropis rubellus	rosyface shiner			R
Cyprinella spiloptera	spotfin shiner			N
Notropis stramineus	sand shiner		N	N
Notropis volucellus	mimic shiner			N
Notropis texanus	weed shiner			N
Phoxinus eos	northern redbelly dace	N	N	
Phoxinus neogaeus	finescale dace	N	N	N
Pimephales notatus	bluntnose minnow			R
Pimephales promelas	fathead minnow	N	N	N

SCIENTIFIC NAME	COMMON NAME	ALBERTA	SASKATCHEWAN	MANITOBA
Platygobio gracilis	flathead chub	N	N	N
Ptychocheilus oregonensis	pikeminnow (northern squawfish)	N		
Rhinichthys atratulus	blacknose dace		N	N
Rhinichthys cataractae	longnose dace	N	N	N
Richardsonius balteatus	redside shiner	N		
Semotilus atromaculatus	creek chub		N	
Catostomidae	**Sucker**			
Carpiodes cyprinus	quillback	R	N	N
Catostomus catostomus	longnose sucker	N	N	N
Catostomus commersoni	white sucker	N	N	N
Catostomus macrocheilus	largescale sucker	R		
Catostomus platyrhynchus	mountain sucker	N	N	
Ictiobus cyprinellus	bigmouth buffalo		N	N
Moxostoma anisurum	silver redhorse	R	N	N
Moxostoma macrolepidotum	shorthead redhorse	R	N	N
Moxostoma erythrurum	golden redhorse			N
Ictaluridae	**Bullhead catfish**			
Ameiurus melas	black bullhead		N	N
Ameiurus nebulosus	brown bullhead		N	N
Ictalurus punctatus	channel catfish		N	N
Noturus flavus	stonecat	R	N	N
Noturus gyrinus	tadpole madtom		N	N
Esocidae	**Pike**			
Esox lucius	northern pike	N	N	N
Esox masquinongy	muskellunge			N
Salmonidae	**Trout**			
Coregonus artedi	cisco (lake herring)	N	N	N
Coregonus clupeaformis	lake whitefish	N	N	N
Coregonus nigripinnis	blackfin cisco		I	N
Coregonus zenithicus	shortjaw cisco	N	N	N
Oncorhynchus aguabonita	golden trout	I		
Oncorhynchus clarki	cutthroat trout	N/I		I
Oncorhynchus kisutch	coho salmon	I	I	
Oncorhynchus mykiss	rainbow trout	N/I	I	I
Oncorhynchus nerka	sockeye salmon	I		I
Prosopium coulteri	pygmy whitefish	N		
Prosopium cylindraceum	round whitefish	N	N	N

SCIENTIFIC NAME	COMMON NAME	ALBERTA	SASKATCHEWAN	MANITOBA
Prosopium williamsoni	mountain whitefish	N		
Salmo salar	Atlantic salmon	I		
Salmo trutta	brown trout	I	I	I
Salvelinus alpinus	Arctic char	I		N
Salvelinus confluentus	bull trout	N		
Salvelinus fontinalis	brook trout	I	I	N
Salvelinus malma	Dolly Varden char	I		
Salvelinus namaycush	lake trout	N	N	N
Thymallus arcticus	Arctic grayling	N	N	N
	splake		I	I
Osermeridae	**Smelt**			
Osmerus mordax	rainbow smelt			I
Percopsidae	**Trout-perch**			
Percopsis omiscomaycus	trout-perch	N	N	N
Gadidae	**Cod**			
Lota lota	burbot	N	N	N
Cyprinodontidae	**Killifish**			
Fundulus diaphanus	banded killifish			R
Gasterosteidae	**Stickleback**			
Culaea inconstans	brook stickleback	N	N	N
Gasterosteus aculeatus	threespine stickleback	I		N
Pungitius pungitius	ninespine stickleback	N	N	N
Serranidae	**Sea bass**			
Monone chysops	white bass			N
Cottidae	**Sculpin**			
Cottus asper	prickly sculpin	N?		
Cottus bairdi	mottled sculpin			N
Cottus cognatus	slimy sculpin	N	N	N
Cottus confusus	shorthead sculpin	N		
Cottus ricei	spoonhead sculpin	N	N	N
Myoxocephalus thompsoni	deepwater sculpin	N	N	N
Centrarchidae	**Sunfish**			
Ambloplites rupestris	rock bass		N	N
Lepomis gibbosus	pumpkinseed	I		N/I
Lepomis macrochirus	bluegill sunfish			I
Micropterus dolomieu	smallmouth bass	I	I	I
Micropterus salmoides	largemouth bass	I	I	I

SCIENTIFIC NAME	COMMON NAME	ALBERTA	SASKATCHEWAN	MANITOBA
Pomoxis annularis	white crappie			I
Pomoxis nigromaculatus	black crappie			I
Percidae	**Perch**			
Etheostoma exile	Iowa darter	N	N	N
Etheostoma nigrum	Johnny darter		N	N
Perca flavescens	yellow perch	N	N	N
Percina caprodes	logperch	N	N	N
Percina maculata	blackside darter		N	N
Percina shumardi	river darter			N
Stizostedion canadense	sauger	R	N	N
Stizostedion vitreum	walleye	N	N	N
Scaenidae	**Drum**			
Aplodinotus grunniens	freshwater drum		N	N

N=native species, I=introduced species, R=river species.

Table 2 Lake habitat requirements data for silver lamprey

[1]**Species Lake Habitat Requirements Data Sheet**									
Species:	*Ichthyomyzon unicuspis*		Silver lamprey		**Morph:**				
Habitat Features:	**Ratings**[1]				**Sources**[2]				**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	nil	nil	high	nil	nil	nil	124	nil	
Depth: (m)									
0-1			high						
1-2			high						
2-5			high				124		
5-10			high				124		
10+			high				124		
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel									
Sand									
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic			high				124		
Cover:									
None			high				124		
Submergents									
Emergents									
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 3 Lake habitat requirements data for lake sturgeon

Species Lake Habitat Requirements Data Sheet									
Species:	*Acipenser fulvescens* Lake sturgeon				**Morph:**				
Habitat Features:	**Ratings[1]**				**Sources[2]**				**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	low	med	high	high	124, 18, 8, 77	124,140, 18, 78	124,140, 18	124,140, 18, 79	
Depth: (m)									
0-1	high				18, 140, 77				
1-2	high		high	high	18, 140, 77		124	124, 79	
2-5	high	[e]high	high	high	18, 140, 77	78	124	124, 79	
5-10		[e]high	high	high		78	124	124, 79	
10+				high				124, 79	
Substrate:									
Bedrock									
Boulder	high				77				
Cobble	high				77				
Rubble	high	med			124,140, 77	78			
Gravel	high	med	high	low	124, 77	124, 78	124	124, 79	
Sand	high	high	low	low	77	45, 78	124	79	
Silt-Clay		high	high	high		18, 78	124, 18	18, 79	
Muck (Detritus)		high	high	high		18	124, 18	124, 18	
Hard-pan clay	high				77				
Pelagic									
Cover:									
None									
Submergents		low				78			
Emergents		low				78			
Overhead									
In Situ	high				77				
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 4 Lake habitat requirements data for goldeye

Species Lake Habitat Requirements Data Sheet									
Species:	*Hiodon alosoides*		Goldeye		**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			Comments
Categories	**Spawn/Egg**	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 124, 70, 18	108, 124, 18	108, 124, 18	108, 124, 18	
Depth: (m)									
0-1	high	high			70	72			
1-2	high	high	high	high	70	72	129, 72	129, 72	
2-5			high	high			129, 72	129, 72	
5-10									
10+									
Substrate:									
Bedrock									
Boulder				high				52	
Cobble		high	high	high		72	52	52	
Rubble		high	high	high		72	52	52	
Gravel			high	high			52	52	
Sand		high				52			
Silt-Clay		high				52			
Muck (Detritus)			high	high			124, 129	124, 129	
Hard-pan clay									
Pelagic	high	high			70	124			
Cover:									
None									
Submergents									
Emergents									
Overhead									
In Situ									
Other specify?		turbidity	turbidity	turbidity		124, 70	124, 70	124, 70	
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 5 Lake habitat requirements data for mooneye

Species Lake Habitat Requirements Data Sheet									
Species:	*Hiodon tergisus*		Mooneye		**Morph:**				
Habitat Features:			**Ratings[1]**				**Sources[2]**		Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:		med	med	med		124	124	124	
Depth: (m)									
0-1									
1-2			med	med			124	124	
2-5			med	med			124	124	
5-10			med	med			124	124	
10+			low	low			124	124	
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel			med	med				79	
Sand			high	high				79	
Silt-Clay			low-nil	low-nil			124	124	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents									
Emergents									
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 6 Lake habitat requirements data for central mudminnow

Species Lake Habitat Requirements Data Sheet									
Species:	*Umbra limi*	Central mudminnow			**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	med	med	med	18, 77	78	124	79	
Depth: (m)									
0-1	high	high	high	high	18, 77	78	124	79	
1-2		high				78			
2-5									
5-10									
10+									
Substrate:									
Bedrock									*use of in situ flooded vegetation regardless of substrate
Boulder									
Cobble									
Rubble									
Gravel				low				79	
Sand				high				79	
Silt-Clay		high		high	77	78		79	
Muck (Detritus)		high	high	high		124	124	124	
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high		high	high	18, 77		124	124,79	
Emergents	high	high	high	high	18, 77	78	124	124,79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 7 Lake habitat requirements data for common carp

Species Lake Habitat Requirements Data Sheet									
Species:	*Cyprinus carpio*	Common carp		**Morph:**					
Habitat Features:		**Ratings**[1]			**Sources**[2]				**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	high	high	high	high	124, 35, 18, 77	124, 35, 18, 78	124, 35, 18	124, 35, 18, 79	
Depth: (m)									
0-1	high	high	high	high	124, 35, 77	35, 18, 78	35, 18	18, 79	
1-2	high	high	high	high	124, 35, 77	35, 18, 78	35, 18	18, 79	
2-5				high				18, 79	
5-10				high				35	
10+									
Substrate:									
Bedrock									
Boulder									
Cobble			med	med			35, 125	125	*use of in situ flooded vegetation regardless of substrate
Rubble		high	med	low	77	78	35, 125	125, 79	
Gravel		high	high	med	77	18, 78	35, 125, 18	125, 18, 79	
Sand		high	high	high	124, 77	18, 78	35, 125, 18	125, 18, 79	
Silt-Clay		high	med	high	124, 35, 77	35, 18, 78	35, 125, 18	35, 125, 18, 79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None			med	med			125	125	
Submergents	high	high	high	high	124, 35, 77	35, 18, 114, 78	35, 18, 114	35, 18, 114	
Emergents	high	high	med	med	124, 35, 77	35, 18, 114, 78	35, 18, 125, 114	35, 125, 18, 114, 79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 8 Lake habitat requirements data for lake chub

Species Lake Habitat Requirements Data Sheet									
Species:	*Couesius plumbeu* Lake chub				**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	108, 124, 103, 77, 11	108, 124, 103, 78	108, 124, 103, 14	108, 124, 103, 79	
Depth: (m)									
0-1	high	high	high	high	124, 14, 77, 11	14, 78, 11	14	14, 11	
1-2	high	high	high	high	124, 14, 77, 11	14, 78, 11	14	14, 11	
2-5			high	high			14	14, 11	
5-10			med	med			50	128, 50	
10+			med	high			50	128, 50, 79	
Substrate:									
Bedrock									
Boulder	med	high		high	77	14, 50		14, 50	
Cobble	high	high			14, 77, 11	124, 103, 14, 11			
Rubble	high	high		med	124, 14, 77, 11	124, 103, 14, 50, 78, 11		79	
Gravel	high	high		high	14, 77, 11	103, 14, 78		79	
Sand	med	med		med	14, 77, 11	14, 11		11	
Silt-Clay	med	med			14, 77, 11	14, 11			
Muck (Detritus)	med	med			14, 11	14, 11			
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents		med		low		14, 50		14, 50	
Emergents		med		nil		14, 50		14, 50	
Overhead									
In Situ	high			med	77			14, 79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 9 Lake habitat requirements data for brassy minnow

Species Lake Habitat Requirements Data Sheet									
Species:	*Hybognathus hankinsoni* Brassy minnow				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:		low	low	low		124, 18, 78	124, 18	124, 18, 79	
Depth: (m)									
0-1		med	med	med		78		79	
1-2		med	med	med		78		79	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel		med	med	med		78		79	
Sand		med	med	med		78		79	
Silt-Clay	high	med	med	med	124	78		79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	med	med	med	med	124	78	124	124, 79	
Emergents			med	med			124	124	
Overhead									
In Situ	high				124				
Other specify?									
Other specify?									

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[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 10 Lake habitat requirements data for silver chub

Species Lake Habitat Requirements Data Sheet									
Species:	*Macrhybopsis storeriana*	Silver chub			**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	low	med	med	high	124	124	124	124	
Depth: (m)									
0-1	med			high	77			124, 79	
1-2	med			high	77			124, 79	
2-5	med			high	77			124, 79	
5-10	med			high	124, 77			124	
10+	med			high	77			124	
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel	high			high	77			79	
Sand	med	high	high	high	77	114	114	114, 79	
Silt-Clay		high		high		78		79	
Muck (Detritus)									
Hard-pan clay									
Pelagic	med				124, 18				
Cover:									
None		med	med	med		114	114	114	
Submergents			med	med			114	114, 79	
Emergents			med	med				79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 11 Lake habitat requirements data for pearl dace

Species Lake Habitat Requirements Data Sheet

Species:	*Margariscus margarit.* Pearl dace				Morph:				Comments
Habitat Features:		Ratings[1]				Sources[2]			
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 124	108, 124	108, 124	108, 124	
Depth: (m)									
0-1	high	high	high	high	108, 124, 103, 11	108, 103, 11		79	
1-2		high	high	high		108, 103, 11	108, 103, 11	79	
2-5		med	high	high		103, 11	103, 11	103, 11	
5-10			high	high			103, 11	103, 11	
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel	high				124, 103, 18, 11				
Sand	high				124, 103, 11				
Silt-Clay	high	high	high	high	103, 11	103, 11	103, 11	103, 11	
Muck (Detritus)	high	high	high	high	103, 11	103, 11	103, 11	103, 11	
Hard-pan clay	high	high	high	high	103, 11	103, 11	103, 11	103, 11	
Pelagic									
Cover:									
None									
Submergents	high	high	high	high	103, 11	103, 11	103, 11	103, 11	
Emergents	high		high	high	103, 11			79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 12 Lake habitat requirements data for golden shiner

Species Lake Habitat Requirements Data Sheet									
Species:	*Notemigonus crysoleucas*		Golden shiner		**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	124	124	124	124	
Depth: (m)									
0-1		high	high	high		124	124	124	
1-2	high	high	high	high	124, 18	124	124	124	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel									
Sand	high				18				
Silt-Clay	high				18				
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high	high	high	high	124, 18	124	124	124	
Emergents	high	high	high	high	124, 18	124	124	124	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 13 Lake habitat requirements data for emerald shiner

Species Lake Habitat Requirements Data Sheet									
Species:	*Notropis atherinoides*	Emerald shiner			**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 77	108, 78	124	108, 79	
Depth: (m)									
0-1	high	high	high	high	77	78	108, 124	124, 114	
1-2	high	high	high	high	77	78	108, 124	124, 79	
2-5	high	high	high	high	77	108, 78	108	124, 79	
5-10	high	high	high	high	77	124	108, 124	124, 79	
10+			high	high			124, 18	124, 18	
Substrate:									
Bedrock									
Boulder	med				77				
Cobble	med		med	med	77		125	125	
Rubble	high	high	med	med	77	78	125	125	
Gravel	high		med	med	77		125	125	
Sand	high	high	high	high	77	125, 114, 78	125, 114	125, 114, 79	
Silt-Clay		high	med	med		78	125	125, 79	
Muck (Detritus)									
Hard-pan clay									
Pelagic		med	med	high		124	114, 18	108, 114, 18, 79	
Cover:									
None		high	high	high		114	125, 114	125, 114	
Submergents	low	med			77	78			
Emergents	low	med	high	high	77	78	125	125	
Overhead									
In Situ		med	high	high		125	125	125	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 14 Lake habitat requirements data for common shiner

Species Lake Habitat Requirements Data Sheet									
Species:	*Luxilus cornutus*		Common shiner		**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn /Egg	YOY	Juveniles	Adult	
Lake usage:	low	low	low	med	124, 136, 18, 77	124, 136	124, 136	124, 136	
Depth: (m)									
0-1	high	high	high	high	124, 77	124	124	124, 136	
1-2	med	med		high	124	78		79	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble	med			high	77			136, 79	
Gravel	high		high	high	136, 18, 77	78		79	
Sand	med	high	high	med	124, 136, 77	124	124	124, 136, 79	
Silt-Clay			med	med		78		79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None				med				136, 79	
Submergents	low	med		med	77	78		136, 79	
Emergents	low	med		med	77	78		79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 15 Lake habitat requirements data for blacknose shiner

Species Lake Habitat Requirements Data Sheet									
Species:	*Notropis heterolepis*		Blacknose shiner		**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	124	124	124	124	
Depth: (m)									
0-1	high	high	high	high	77	124, 78	124	124, 79	
1-2		high	high	high		124, 78	124	124, 79	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel	med	high	high	high	77	124, 78	124	124, 79	
Sand	high			high	124, 77			79	
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high	high	high	high	77	124, 78	124	124, 79	
Emergents	high	high	high	high	77	124, 78	124	124, 79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 16 Lake habitat requirements data for blackchin shiner

Species Lake Habitat Requirements Data Sheet									
Species:	*Notropis heterodon*		Blackchin shiner		**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	132, 124, 77	132, 124, 78	132, 124	132, 124, 79	
Depth: (m)									
0-1	high	high	high	high	77	78	132	79	
1-2		high	high	high		78	132	79	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel	high		high	high	18, 77		18, 132	18, 79	
Sand	high		high	high	18, 77		132	79	
Silt-Clay	high	high	high	high	18, 77	18, 78	132	79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high	high	high	high	132, 124, 18, 77	132, 124, 18, 78	132, 124, 18	132, 124, 18, 79	
Emergents	high	med	high	med	132, 124, 77	132, 124, 78	132, 124	132, 124, 79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 17 Lake habitat requirements data for spottail shiner

Species Lake Habitat Requirements Data Sheet									
Species:	*Notropis hudsonius*	Spottail shiner			**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	108, 124, 18, 77	108, 124, 18, 78	108, 124, 18	108, 124, 18, 79	
Depth: (m)									
0-1	high	high	high	high	124, 77	18, 78	18	124, 18, 79	
1-2	high	high	high	high	124, 77	78	18	124, 79	
2-5	med	high		high	124, 77	78		124, 79	
5-10		high		high		78		124, 79	
10+		high		high		78		79	
Substrate:									
Bedrock									
Boulder									
Cobble	med		med	med	77		125	125	
Rubble	med			med	77			79	
Gravel	high	high	med	high	77	78	125	125, 79	
Sand	high	high	high	high	124, 77	78	125	125, 79	
Silt-Clay		med	high	med		78	125	125, 79	
Muck (Detritus)									
Hard-pan clay									
Pelagic			med	med			108, 18	108, 18	
Cover:									
None			med	med			125	125	
Submergents	med	high	med	high	124, 77	78	125	125, 79	
Emergents	med	high	high	high	77	78	125	125	
Overhead									
In Situ			med	med			125	125	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 18 Lake habitat requirements data for sand shiner

Species Lake Habitat Requirements Data Sheet									
Species:	*Notropis stramineus*	Sand shiner			**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:		low	low	low		124, 18	124, 18	124, 18	
Depth: (m)									
0-1	high	med	med	med	77	124, 114	124, 114	124, 114, 79	
1-2	high	med	med	med	77	124, 114	124, 114	124, 114, 79	
2-5				med				79	
5-10				med				79	
10+				med				79	
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel	high	med	low	high	18, 77	114	114	114	
Sand	high	med	low	med	124, 18, 77	124, 114	124, 114	124, 114	
Silt-Clay	med		high	high	77		114	114	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None			low	med			114	114	
Submergents	low				77				
Emergents	low				77				
Overhead									
In Situ			high	high			114	114, 79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 19 Lake habitat requirements data for northern redbelly dace

Species Lake Habitat Requirements Data Sheet									
Species:	*Phoxinus eos*		Northern redbelly da		**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	108, 124, 18, 27	108, 124, 18	108, 124, 18	108, 124, 18	
Depth: (m)									
0-1	high	high		high	77	78		79	
1-2	high	high		high	77	78		79	
2-5				med				79	
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel				high	108			79	*over substrate associated with vegetation
Sand				high	108			79	
Silt-Clay		high		high	108	124, 78		124	
Muck (Detritus)		high		high	108	124		124	
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high			high	124, 77			79	
Emergents				high				79	
Overhead									
In Situ				high				79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 20 Lake habitat requirements data for finescale dace

Species Lake Habitat Requirements Data Sheet									
Species:	*Phoxinus neogaeus*	Finescale dace			**Morph:**				
Habitat Features:	**Ratings**[1]				**Sources**[2]				**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	med	med	med	med	108, 124	108, 124	108, 124	108, 124	
Depth: (m)									
0-1	high	high		high	77	78		79	
1-2	high	high		high	77	78		79	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel	med			high	77			79	
Sand	high			high	77			79	
Silt-Clay	high	high		high	77	78		79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents				high				79	
Emergents				high				79	
Overhead	high				108				
In Situ	high	high		high	77	78		79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered referances.

Table 21 Lake habitat requirements data for fathead minnow

Species Lake Habitat Requirements Data Sheet									
Species:	*Pimephales promela* Fathead minnow				**Morph:**				
Habitat Features:		Ratings[1]			Sources[2]				**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	med	med	med	med	108, 124, 18, 77	108, 124, 18, 114, 78	108, 124, 18, 114	108, 124, 18, 114, 79	
Depth: (m)									
0-1	high	high	high	high	108, 124, 77	114, 78	124, 114	114, 79	
1-2	high	high	high	high	108, 124, 77	114, 78	124, 114	114, 79	
2-5			low	low			114	114	
5-10									
10+									
Substrate:									
Bedrock	*				103, 18				
Boulder	*				18, 11				
Cobble	*		med	med	124		125	125, 79	*Use of in-situ hard materials regardless of substrate composition.
Rubble	*		med	med	124		125	125, 79	
Gravel	*		low	high	124, 12, 77		125	125, 79	
Sand	*	high	med	high	124, 12, 77	78	125	125, 79	
Silt-Clay	*	high	med	high	124, 12, 77	114, 78	125, 114	125, 114, 79	
Muck (Detritus)	*				124				
Hard-pan clay	*				124				
Pelagic									
Cover:									
None			high	high			125, 114	125	
Submergents	med	med		high	108, 124, 18, 77	78		79	
Emergents	med	med	med	high	108, 124, 18, 77	78	125	125, 79	
Overhead	high				124, 18				
In Situ	high		med	high	108, 124, 18, 77		125	125, 79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 22 Lake habitat requirements data for flathead chub

Species Lake Habitat Requirements Data Sheet									
Species:	*Platygobio gracilis*	Flathead chub		**Morph:**					
Habitat Features:		Ratings[1]				Sources[2]			**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	124	124	124	124	
Depth: (m)									
0-1				high				114	
1-2									
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel				high				114	
Sand				high				114	
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None				high				114	
Submergents				high				114	
Emergents									
Overhead									
In Situ				high				114	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 23 Lake habitat requirements data for longnose dace

Species Lake Habitat Requirements Data Sheet									
Species:	*Rhinichthys cataractae* Longnose dace				Morph:				Comments
Habitat Features:	Ratings[1]				Sources[2]				
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	124, 11	108, 124	108, 124	108, 124	
Depth: (m)									
0-1	high	high	high	high	124, 103, 36, 18, 11	124, 103, 36, 18, 11	124, 103, 36, 18, 11	124, 103, 36, 18, 11	
1-2	high	med	med	med	124, 103, 36, 11	124, 103, 36, 11	124, 103, 36, 11	124, 103, 36, 11	
2-5		med	med	med		124, 103, 11	124, 103, 36, 11	124, 103, 36, 11	
5-10		med	med	med		124, 103, 11	124, 103, 36, 11	124, 103, 36, 11	
10+			med	med			124	124	
Substrate:									
Bedrock									
Boulder	high	high	high	high	124, 103, 11	108, 124, 103, 11	124, 103, 36, 11	124, 103, 11	
Cobble	high	high	high	high	124, 103, 11	108, 124, 103, 11	124, 103, 36, 11	124, 103, 11	
Rubble	high	high	high	high	124, 103, 11	108, 124, 103, 11	124, 103, 36, 11	124, 103, 11	
Gravel	high	high	high	med	108, 124	108, 124, 103, 36, 11	124, 103, 36, 11	124, 103, 11	
Sand		high				108, 124, 103, 11			
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic		med	med	med		124, 103, 36, 11	103, 11	103, 11	
Cover:									
None									
Submergents				med				124, 103, 11	
Emergents				med				124, 103, 11	
Overhead		high	high	med		124, 103, 36, 11	36	124, 103, 36, 11	
In Situ		med	med	med		124, 103, 36, 11	36	36	
Other specify?	turbidity	turbidity	turbidity	turbidity	36	36	36	36	
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 24 Lake habitat requirements data for redside shiner

Species Lake Habitat Requirements Data Sheet									
Species:	*Richardsonius balteatus* Redside shiner				**Morph:**				
Habitat Features:	Ratings[1]					Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	124, 18	108, 124	108, 124	108, 124	
Depth: (m)									
0-1	med	med	med	med	124	124	124	124	
1-2		med	med	med		124	124	124	
2-5		med	med	med		124	124	124	
5-10			low	low			124	124	
10+			low	low			124	124	
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel	high				124				
Sand									
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic			med	med			124	124	pelagic at night
Cover:									
None									
Submergents	high	high	high	high	124	124, 18	124, 18	124, 18	
Emergents	high	high	high	high	124	124, 18	124, 18	124, 18	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 25 Lake habitat requirements data for creek chub

Species Lake Habitat Requirements Data Sheet									
Species:	*Semotilus atromacul* Creek chub				**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	low-nil	med	med	med	124,114,18	124, 78	124	124, 79	
Depth: (m)									
0-1		med	med	med		114	114	114	
1-2		med	med	med		78		79	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel	high	med	med	med	114, 18	78		79	
Sand		med	med	med		114	114	114	
Silt-Clay		med	med	med		114	114	114	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents		med	med	med		78		79	
Emergents		med	med	med		78		79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 26 Lake habitat requirements data for quillback

Species Lake Habitat Requirements Data Sheet									
Species:	*Carpiodes cyprinus*	Quillback			**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage	med	med	med	med	108, 124, 18, 77	108, 124, 18	108, 124, 18	108, 124, 18	
Depth: (m)									
0-1	med	med			114, 77	78			
1-2	med	med		med	77	78		79	
2-5				med				79	
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble				low				79	
Gravel	med	high	high	high	77	114	114	114	
Sand	high	high	high	high	114, 77	114	114	114	
Silt-Clay	high			high	124, 114, 77			79	
Muck (Detritus)	med				124				
Hard-pan clay									
Pelagic									
Cover:									
None	med	med	med	med	114	114	114	114	
Submergents		med		med		78		79	
Emergents									
Overhead									
In Situ									
Other specify?	high turbidity				77				
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 27 Lake habitat requirements data for longnose sucker

Species Lake Habitat Requirements Data Sheet									
Species:	*Catostomus catastomus* Longnose sucker				**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	108, 124, 57, 18	108, 124, 57, 18	108, 124, 57, 18	108, 124, 57, 18	
Depth: (m)									
0-1	high	high	high		124, 33	108, 33	33		
1-2			high				11		
2-5			high				11		
5-10									
10+				high				33, 11	
Substrate:									
Bedrock									
Boulder		high				33, 11			
Cobble	low				11				
Rubble	high	high			33, 57, 11	33, 11			
Gravel	high	high			108, 124, 33, 57, 11	124, 33	33	33	
Sand	low				108, 11		33	33	*associated with aquatic vegetation
Silt-Clay									
Muck (Detritus)							33	33	
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents		high	high	high		13, 11	11	33	
Emergents		high	high			13, 11	11		
Overhead									
In Situ				high				11	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 28 Lake habitat requirements data for white sucker

Species Lake Habitat Requirements Data Sheet									
Species:	*Catostomus commersoni* White sucker				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	low	med	med	med	108, 124, 18, 11	108, 124	108, 124	108, 124	
Depth: (m)									
0-1	high	high	high	high	124, 11	108, 124, 11	108, 124, 31, 11	124, 31, 11	
1-2	low	high	high	high	11	124, 31, 11	124, 31, 11	124, 31, 11	
2-5		high	high	high		124, 31, 11	124, 31, 11	124, 31, 11	
5-10		low	med	med		11	124, 31, 11	124, 31, 11	
10+			med	med			124	124, 31	
Substrate:									
Bedrock									
Boulder									
Cobble			med				125		
Rubble			med	med			125	125	
Gravel	high	high			124, 18, 11	124			
Sand	med		med	med	108, 18		125	125	
Silt-Clay	med		med	med	125, 18		125	125	
Muck (Detritus)		med	med			11	11		
Hard-pan clay									
Pelagic		low	med	med		11	11	11	
Cover:									
None			med	med			125	125	
Submergents									
Emergents	med		med	med	125		125	125	
Overhead									
In Situ				high				11	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 29 Lake habitat requirements data for bigmouth buffalo

Species Lake Habitat Requirements Data Sheet									
Species:	*Ictiobus cyprinellus*	Bigmouth buffalo			**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	124,34,18,77	124,34,18,77	124,12,34,18	124,34,18,79	
Depth: (m)									
0-1	med	high	high	high	124,34,12,18,77	124,78	125	125	
1-2	med	high	high	high	124,34,12,18,77	124,78	125	125	
2-5	med	high	high	high	124,12,18,77	125	125	124,79	
5-10			high	high			12	12	
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									*use of flooded vegetation regardless of substrate
Rubble			med	med	125,77		125	125	
Gravel				med	77			79	
Sand			med	med	77		125	79	
Silt-Clay		high		low	77	78		79	
Muck (Detritus)		high	high	high	34	34	34	34	
Hard-pan clay									
Pelagic			high	high			12	12	
Cover:									
None	med		med		125		125		
Submergents	high	med		high	34,18,77	78		79	
Emergents	high			med	34,18,77			125,79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 30 Lake habitat requirements data for silver redhorse

Species Lake Habitat Requirements Data Sheet									
Species:	*Moxostoma anisurum* Silver redhorse				**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	nil- low	low	low	low	108, 124	108, 124, 18, 77	108, 124, 18	108, 124, 18, 79	
Depth: (m)									
0-1	high				124, 77				
1-2		med	med	med		124	124	124	
2-5				med				124	
5-10				med				124	
10+									
Substrate:									
Bedrock									
Boulder									
Cobble	high				77				
Rubble	high		med	med	124, 77			79	
Gravel	high	med	high	high	124, 77	124	124	124, 79	
Sand		med	high	high		124	124	124	
Silt-Clay	nil	nil	nil	nil	124	124	124	124	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents									
Emergents		med				78			
Overhead		high	high	high		124	124	124	
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 31 Lake habitat requirements data for shorthead redhorse

Species Lake Habitat Requirements Data Sheet									
Species:	*Moxostoma macrolepidotum* Shorthead redhorse				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage	nil	med	med	med	108, 18, 114	108, 124, 18	108, 124, 18	108, 124, 18	
Depth: (m)									
0-1		med	med	med		114, 78	114	114	
1-2		med	med	med		124, 78	124	124	
2-5				med				79	
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble				med				79	
Rubble				high				79	
Gravel		med	med	med		124, 114, 78	124, 114	124, 114, 79	
Sand		med	med	med		124, 114, 78	124, 114	124, 114, 79	
Silt-Clay		nil	nil	med		124	124	79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents				low				79	
Emergents									
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 32 Lake habitat requirements data for black bullhead

Species Lake Habitat Requirements Data Sheet								
Species:	*Ameiurus melas*	Black bullhead		**Morph:**				
Habitat Features:		Ratings[1]			Sources[2]			**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	77	124,133,78	124,133	124,133,79	
Depth: (m)									
0-1	high	high	high	high	124,77	133,78	133	133,79	
1-2	high	high	high	high	124,77	133,78	133	133,79	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble	low				77				
Rubble	low				77				
Gravel	low			med	124,77			79	
Sand	high	high		high	133,77	124,78		124,79	
Silt-Clay	high	high	high	high	124,133,77	124,78	124	124,79	
Muck (Detritus)		high	high	high		124	124	124	
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high	high	high	med	124,133,77	133	133	133,79	
Emergents	high	high	high	high	124,133,77	133,78	133	133,79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 33 Lake habitat requirements data for brown bullhead

Species Lake Habitat Requirements Data Sheet									
Species:	*Ameiurus nebulosus*	Brown bullhead			**Morph:**				
Habitat Features:		Ratings¹				Sources²			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	18,77	18,78	18	18,79	
Depth: (m)									
0-1	high	high	high	high	77	124,78	124	124,79	
1-2	high	high	high	high	77	124,78	124	124,79	
2-5				high				124,79	
5-10				low				124	
10+				low				124	
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble		high				78			
Gravel		high		med		78		79	
Sand	high	high	high	high	124,77	124,78	124	79	
Silt-Clay	high	med	med	high	124,77	124,78	124	79	
Muck (Detritus)		med	med			124,78	124	124,79	
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	med	high	high	high	124,77	124,78	124	124,79	
Emergents	med	high	high	high	124,77	124,78	124	124,79	
Overhead									
In Situ	high				124,77				
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 34 Lake habitat requirements data for channel catfish

Species Lake Habitat Requirements Data Sheet									
Species:	*Ictalurus punctatus* Channel catfish				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Embryo	YOY	Juvenile	Adult	Spawn/Embryo	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	124,77	124, 18, 78	124,18	124, 18, 79	
Depth: (m)									
0-1	med		high	low	77		114	114, 78	
1-2	med			med	77			114, 18, 79	
2-5	med	high		high	77	78		124, 114, 18, 79	
5-10		high		high		78		124	
10+		high				78			
Substrate:									
Bedrock	low				132				
Boulder									
Cobble	high	med			77	78			
Rubble	high	high	med	high	124,77	124, 114, 18, 78	124, 114, 18,	124, 114, 18, 79	
Gravel	high	high	high	med	77	114, 78	114	124, 114, 79	
Sand	high	med	med	med	77	114, 18	114, 18	124, 114, 18, 79	
Silt-Clay	high	high	high	high	77	114, 18	114, 18	114, 18	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None		high	high	low		114	114	114	
Submergents	low	low	low	low	77	124,78	124, 132,18	124, 132	
Emergents	low	low	low	low	77	124,78	124, 132,18	124, 132	
Overhead	high	med	med	high	124,77	114	114, 18	114, 18	
In Situ	high	high	high	high	124	124	124,114	124,114	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 35 Lake habitat requirements data for tadpole madtom

Species Lake Habitat Requirements Data Sheet									
Species:	*Noturus gyrinus*		Tadpole madtom		**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	low	low	med	med	124, 18, 77	124, 18, 78	124, 18	124, 18, 79	
Depth: (m)									
0-1	med	high	high	high	124, 77	124, 78	124	124, 79	
1-2	med	high	high	high	124, 77	124, 78	124	124, 79	
2-5		high	high	high		124, 78	124	124, 79	
5-10			high	high			124	124, 79	
10+			high	high			124	124, 79	
Substrate:									
Bedrock									
Boulder		low	med	med		124, 78	124	124, 79	
Cobble				med				79	
Rubble									
Gravel	med			high	77			79	
Sand	high	high	high	high	77	124, 78	124	124, 79	
Silt-Clay	high	high	high	high	77	124, 78	124	124, 79	
Muck (Detritus)		med	med	med		124	124	124	
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	med	high	high	high	124, 77	124, 78	124	124, 79	
Emergents	med	high	high	high	124, 77	124, 78	124	124, 79	
Overhead									
In Situ	high			high	124, 77			79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 36 Lake habitat requirements data for northern pike

Species Lake Habitat Requirements Data Sheet									
Species:	*Esox lucius*	Northern pike			Morph: [illegible]				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 103, 45, 63, 16, 22	108, 103, 45, 63, 21	108, 103, 45, 63, 21	108, 103, 45, 63	
Depth: (m)									
0-1	high	high	high	high	45, 63, 22, 20, 50, 77	20, 47, 78	45, 62		
1-2	med	med	high	high	22, 41, 48, 77	20, 47, 78	45, 62	20, 30, 73, 79	
2-5	low	low		high		20, 47, 73, 78		20, 30, 79	
5-10	low			med				20, 30, 79	
10+	nil			low	20			20, 30, 79	
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble	*		low	low	77		125	125, 85	
Gravel	*			low	77			79	
Sand	*			high	77			79	*use of in situ flooded vegetation regardless of substrate
Silt-Clay	*	high	high	high	108, 63, 50, 125, 77	78	50, 125	125	
Muck (Detritus)	*		high	high	108, 63		50	50	
Hard-pan clay	*	high	high	high	11	11	11	11	
Pelagic				high				11	
Cover:									
None	low	low	low	med	20	20, 85	20, 125	125	
Submergents	high	high	high	high	108, 63, 77	63, 20, 93, 78	20, 93	20, 73, 93, 79	
Emergents	high	high	med	high	20, 125, 77	63, 73, 93	125, 73, 93	20, 125, 73, 93, 85	
Overhead									
In Situ			med	high			124	63, 29, 125	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 37 Lake habitat requirements data for muskellunge

Species Lake Habitat Requirements Data Sheet									
Species:	*Esox masquinongy* Muskellunge				Morph:				
Habitat Features	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage	high	high	high	high	124, 18, 77	124, 18, 78	124, 18	124, 18, 79	
Depth (m)									
0-1	high	high	high	high	124, 25, 18, 77	25, 78	124	124, 79	
1-2	med	high	high	high	124, 25, 77	78	124	124, 79	
2-5			high	high			124	124, 79	
5-10	low		high	high	25		124	124, 79	
10+			low	low			124	124, 79	
Substrate:									
Bedrock			high	med			25	25	
Boulder									
Cobble									
Rubble									
Gravel				low				79	*use of in-situ flooded vegetation regardless of substrate
Sand		med	high	high	25, 77	78	25	79	
Silt-Clay		high		high	77	78		79	
Muck (Detritus)		high			25	25			
Hard-pan clay									
Pelagic									
Cover:									
None	low				25				
Submergents	high	high	high	high	124, 25, 77	124, 78	124, 25	124, 25, 79	
Emergents	high	high	high	high	124, 25, 77	124, 25	124, 25	124, 79	
Overhead									
In Situ	high	high	high	high	124, 25, 77	124	124	124, 79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 38 Lake habitat requirements data for cisco

Species Lake Habitat Requirements Data Sheet									
Species:	*Corogonus artedi* Cisco (Lake herring)				**Morph:**				
Habitat Features:	Ratings¹				Sources²				Comments
Categories	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 124, 18, 77, 23	108, 124, 18, 78	108, 124, 18	108, 124, 18, 79	
Depth: (m)									
0-1	med	high	high	high	108, 50, 18, 77	39, 78	2, 50	79	
1-2	high	high	high	high	108, 124, 50, 18, 77	50, 78	2, 50	50, 79	
2-5	high	high	high	high	108, 124, 50, 18, 77	50, 78	108, 2, 50	50, 79	
5-10	med	high	high	high	108, 124, 77	78	108, 2	108, 50, 79	
10+	med		high	high	124		108, 124, 18	108, 124, 50, 18, 79	
Substrate:									
Bedrock	nil	nil			50	50			
Boulder	med	med			108, 124, 50, 18, 77	50, 78			
Cobble	high	high	high	med	108, 124, 18, 77	50, 78	125, 50	125	
Rubble	high	high	med	med	108, 124, 50, 18, 77	50, 78	125	125	
Gravel	high	med	high		108, 124, 50, 18, 77	78	50		
Sand	high	low	high	med	108, 124, 18, 77	50, 39, 78	50	125	
Silt-Clay	med			med	108, 124, 50, 18, 77			125	
Muck (Detritus)									
Hard-pan clay	low				108, 124, 18, 77				
Pelagic		med	high	high		124, 50, 2	124, 50, 2	108, 124, 50, 79	
Cover:									
None		med	med	med		124	125	125	
Submergents		low				78			
Emergents				med				125	
Overhead									
In Situ			med				125		
Other specify?									
Other specify?									

¹Ratings are nil (default), low, medium or high.
²Sources are numbered and reflect sources found in the numbered references.

Table 39 Lake habitat requirements data for lake whitefish

Species Lake Habitat Requirements Data Sheet									
Species:	*Coregonus clupeaformis*		Lake whitefish		Morph[illegible]				Comments
Habitat Features:		Ratings[1]				Sources[2]			
Categories	Spawn/Egg	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Lake usage:	med	high	high	high	124, 39, 18, 77, 11	124, 39, 77	124, 39	124, 39, 79	
Depth: (m)									
0-1	high	high	high	high	108, 124, 45, 6, 84, 77	67, 18, 123, 11	18, 11	18, 11	
1-2	high	high	high	high	108, 124, 45, 6, 84, 18, 15, 77	124, 67, 18, 123, 11	45, 18	18, 11	
2-5	high	high	high	high	108, 124, 45, 6, 84, 77	124, 18, 67	18, 11	18, 11	
5-10	high	high	high	high	124, 6, 84, 77	124, 18, 67	18, 67, 11	18, 67, 79	
10+	high	med	high	high	84	124, 39, 18, 67	108, 124, 18, 67, 11	108, 124, 103, 6, 94, 67, 18, 79	
Substrate:									
Bedrock									
Boulder	high	high	high	high	108, 124, 45, 84, 77	124, 11	45	45	
Cobble	high	high	high	high	108, 124, 45, 84, 77	124, 18, 11	45, 18	125, 18	
Rubble	high	med	high	med	108, 124, 6, 12, 84, 77, 11	18, 78, 11	18, 11	125, 18, 79	
Gravel	high	high	high	high	124, 45, 6, 84, 77	124, 18, 78, 11	45, 18	18, 79	
Sand	med	high		med	124, 45, 6, 12, 84, 77	124, 78		125, 79	
Silt-Clay	low				15, 84, 77				
Muck (Detritus)	nil			high	11			18, 11	
Hard-pan clay				high				145	
Pelagic		high	high	med		108, 120	108, 45	108, 45	
Cover:									
None		high	high	med		124	124	124	
Submergents		med				120, 79			
Emergents	low	med	high		15, 120	45, 120, 11	45		
Overhead									
In Situ		low	low			45	45		
Other specify?									
Other specify?	-	-	-	-					

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 40 Lake habitat requirements data for shortjaw cisco

Species Lake Habitat Requirements Data Sheet									
Species:	*Coregonus zenithicus* Shortjaw cisco				**Morph:**				
Habitat Features	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage	high	high	high	high	124, 77	124, 78	124	124, 79	
Depth: (m)									
0-1									
1-2									
2-5		med	med	med		108	108	108	
5-10	high	med	med	med	77	124, 78	124	124, 79	
10+	high	high	high	high	124, 77	124, 78	124	124, 79	
Substrate:									
Bedrock									
Boulder	med				77				
Cobble	med				77				
Rubble	med				77				
Gravel	med				77				
Sand	high				77				
Silt-Clay	high	high			77	78			
Muck (Detritus)									
Hard-pan clay	high				77				
Pelagic		high	high	high		124, 78	124	124, 79	
Cover:									
None		high	high	high		124	124	124	
Submergents									
Emergents									
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 41 Lake habitat requirements data for golden trout

Species Lake Habitat Requirements Data Sheet									
Species:	*Oncorhynchus aguabonita*		Golden trout		**Morph:**				**Comments**
Habitat Features:		**Ratings**[1]				**Sources**[2]			
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	med	high	high	high	45, 18	45, 18	45, 18	45, 18	
Depth: (m)									
0-1	high	high	high	high	45, 77, 11	124, 118, 78, 11	124, 45, 11	124, 45, 118, 11	
1-2	high	high	high	high	45, 77, 11	124, 118, 78, 11	124, 45, 11	124, 45, 11	
2-5	low	high	high	high	45, 77, 11	124, 118, 78, 11	124, 45, 11	124, 45, 11	
5-10	med	low	med	high	77	11	124, 45, 11	124, 45, 11	
10+									
Substrate:									
Bedrock									
Boulder		high	high	high		11	11	45, 11	
Cobble		high	high	high		11	45, 11	45, 11	
Rubble	med	high	high	high	45, 77	11	45, 11	118, 11	
Gravel	high	high	low		124, 45, 18, 78, 11	118, 18, 78, 11	118, 11		
Sand		high	low			78, 11	11		
Silt-Clay		high				78			
Muck (Detritus)									
Hard-pan clay									
Pelagic		med		high		11		79	
Cover:									
None									
Submergents	low	low	low	low	11	118, 78, 11	11	124	
Emergents	low	low	low	low	11	11	11	124	
Overhead			high				118		
In Situ		high	high	high		104, 77, 11	104, 45, 118, 11	45, 11	
Other specify?								45	
Other specify?									

[1]Ratings are nil (default), low, medium or high.

[2]Sources are numbered and reflect sources found in the numbered references.

Table 42 Lake habitat requirements data for cutthroat trout

Species Lake Habitat Requirements Data Sheet									
Species:	*Oncorhynchus clarki*	Cutthroat trout			**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			Comments
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	[illegible]	
Lake usage	low	low	med	med	108, 124, 146, 53, 18	124, 53, 18	108, 124, 104, 53, 18	108, 124, 104, 53, 18	
Depth: (m)									
0-1	high	high			45, 146, 97	124			
1-2	high	high			45, 146, 97	124			
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble	high				53				
Rubble									
Gravel	high	high	high	high	124, 45, 146, 53, 97, 18	124	124	124	
Sand	med				108, 45				
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents									
Emergents									
Overhead									
In Situ	med	high	high	high	97	104	104	104	
Other specify?	shade				53				
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 43 Lake habitat requirements data for rainbow trout

Species Lake Habitat Requirements Data Sheet									
Species:	*Oncorhynchus mykiss* Rainbow trout				[illegible]				
Habitat Features:	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sources²			**Comments**
Categories									
Lake usage:	low	med	med	med	108, 124, 45, 18, 77	108, 124, 104, 18, 78	108, 124, 104, 45, 18	108, 124, 104, 118, 18, 79	
Depth: (m)									
0-1	high	high	high	high	45, 77, 11	124, 118, 78, 11	124, 45, 11	124, 45, 118, 11	
1-2	high	high	high	high	45, 77, 11	124, 118, 78, 11	124, 45, 11	124, 45, 11	
2-5	low	high	high	high	45, 77, 11	124, 118, 78, 11	124, 45, 11	124, 45, 11	
5-10	med	low	med	high	77	11	124, 45, 11	124, 45, 11	
10+									
Substrate:									
Bedrock									
Boulder		high	high	high		11	11	45, 11	
Cobble		high	high	high		11	45, 11	45, 11	
Rubble	med	high	high	high	45, 77	11	45, 11	118, 11	
Gravel	high	high	low		124, 45, 18, 77, 11	118, 18, 78, 11	118, 11		
Sand		high	low			78, 11	11		
Silt-Clay		high				78			
Muck (Detritus)									
Hard-pan clay									
Pelagic		med		high		11		79	
Cover:									
None								124	
Submergents	low	low	low	low	11	118, 78, 11	11	124	
Emergents	low	low	low	low	11	11	11	124	
Overhead			high				118		
In Situ		high	high	high		104, 78, 11	104, 45, 118, 11	45, 11	
Other specify?								45	
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 44 Lake habitat requirements data for pygmy whitefish

Species Lake Habitat Requirements Data Sheet									
Species:	*Prosopium coulteri*	Pygmy whitefish			Morph.:				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories:	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	high	high	high	108, 124, 77	108, 124, 78	108, 124	108, 124, 79	
Depth: (m)									
0-1	high				124, 77				
1-2	high				124, 77				
2-5		high				78, 95			
5-10	high	high		high	108, 77	108, 78		108, 124, 95	
10+			high	high			108, 124	108, 124, 79	
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble	high				124, 77				
Gravel	high			med	124, 77			79	
Sand	high	high		high		78		79	
Silt-Clay				high				79	
Muck (Detritus)				low				79	
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents									
Emergents									
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 45 Lake habitat requirements data for round whitefish

Species Lake Habitat Requirements Data Sheet									
Species:	*Prosopium cylindraceum*	Round Whitefish		Morph[illegible]					
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lake usage:	med	med	med	med	124, 67, 18, 110, 77	108, 124, 67, 18, 78	108, 124, 67, 18	108, 124, 67, 18, 79	
Depth: (m)									
0-1	high	nil	high	high	110, 15, 77, 11	110, 11	11	11	
1-2	med	nil	high	high	11	110, 11	11	11	
2-5	low	high	high	high	124, 77, 11	78	11	120, 15, 11	
5-10	low	high	high	high	124, 71, 59, 11	78	124, 18, 11	124, 105, 18, 79, 11	
10+			high	high			124, 18, 11	124, 18, 79, 11	
Substrate:									
Bedrock									
Boulder	med			low	15			79	
Cobble	med	high	high	high	11	110	11	11	
Rubble	high	high	high	high	124, 110, 77	110	11	11	
Gravel	high	high		med	124, 110, 15, 77	78, 11		79	
Sand		high		high		98, 59, 78		120	
Silt-Clay	low			med	15, 11			79	
Muck (Detritus)			high	high			11	11	
Hard-pan clay			high	med			11	79, 11	
Pelagic									
Cover:									
None									
Submergents									
Emergents	low				15, 11				
Overhead									
In Situ		high				110			
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 46 Lake habitat requirements data for mountain whitefish

Species Lake Habitat Requirements Data Sheet									
Species:	*Prosopium williamsoni*	Mountain whitefish			**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	med	med	med	med	124, 108, 18, 111, 71	124, 108, 18, 111	124, 108, 18, 111	124, 108, 18, 111	
Depth: (m)									
0-1	high		high	high	108, 124		45, 111	45, 111	
1-2	high	med	high	high	108, 124	45, 55	108, 45, 111	108, 45, 111	
2-5			high	high			45, 111	45, 111	
5-10	low	high	med	med	55, 111	55	124, 55, 111	124, 55, 111	
10+			med	med			124, 111	124, 111	
Substrate:									
Bedrock									
Boulder		med				111			
Cobble				high				45	
Rubble	high	med			124, 55	111			
Gravel	high		high	high	108, 124, 111		45	45	
Sand			high				45		
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic	low				55				
Cover:									
None									
Submergents		high				55			
Emergents		high				55			
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 47 Lake habitat requirements data for Atlantic salmon

Species Lake Habitat Requirements Data Sheet									
Species:	*Salmo salar*	Atlantic salmon			**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories:	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	low-nil	med	med	med	124,103	18	103,18	18	
Depth: (m)									
0-1	high	high	high	low	11	18,11	11	11	
1-2	low		high	low	11		11	11	
2-5		high	med	high		11	11	11	
5-10			low	high			11	11	
10+			low	low			11	11	
Substrate:									
Bedrock									
Boulder		high	high			11	11		
Cobble		high	high	high		11	11	11	
Rubble		high	high	high		11	11	11	
Gravel	high	high	high	high	124,11	124	124	11	
Sand		med	med	high		18	18	18,11	
Silt-Clay		med	med			18	18		
Muck (Detritus)				low				11	
Hard-pan clay				low				11	
Pelagic			med	high			11	11	
Cover:									
None									
Submergents									
Emergents									
Overhead									
In Situ			high				11		
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 48 Lake habitat requirements data for brown trout

Species Lake Habitat Requirements Data Sheet									
Species:	*Salmo trutta*	Brown trout			**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	med	med	med	med	108, 124, 104	108, 124, 18	108, 124, 104, 18	108, 124, 104, 18	
Depth: (m)									
0-1	high	high	high	low	124, 117, 11	117, 18, 11	117, 18, 11	117, 18, 11	
1-2	high	high	high	low	124, 11	117, 18, 11	117, 18, 11	117, 18, 11	
2-5		low	high	low		117, 18, 11	117, 18, 11	117, 18, 11	
5-10		low	med	high		117, 18, 11	117, 18, 11	117, 18, 11	
10+		low	low	high		117, 11	117, 11	117, 11	
Substrate:									
Bedrock									
Boulder		high	high	high		11	11	11	
Cobble	high	high	high		124, 11	11	11		
Rubble	high	high	high	high	124, 11	11	11	11	* strongly associated with cover and thus the consequential substrate.
Gravel	high	med	med		116, 11	11	11		
Sand		med	med			11	11		
Silt-Clay				med				11	
Muck (Detritus)				med				11	
Hard-pan clay				med				11	
Pelagic			low	med			11	11	
Cover:									
None									
Submergents		low	low	med		124, 11	124, 117, 11	124, 116	
Emergents			low				11		
Overhead		high	high	high		45, 117	108, 117	108, 117	
In Situ		high	high	high		108, 117, 11	108, 117	108, 117	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 49 Lake habitat requirements data for Arctic char

Species Lake Habitat Requirements Data Sheet									
Species:	*Salvelinus alpinus* Arctic char				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	high	high	124,103,18,77	124,18,78, 94	124,18, 94	124,18,79	
Depth: (m)									
0-1	low	low	low	high	11	78,11	11	79,11	
1-2	high	low	low	high	124,103,77,11	78,11	11	79,11	
2-5	high	low	low	high	124,103,77,11	11	11	79,11	
5-10	med	low	high	high	103,18,77,11	11	11	79,11	
10+	med	high	high	high	103,18,77,11	11	11	11	
Substrate:									
Bedrock			low	low			11	11	
Boulder	med	high	high	high	11	78,11	11	79,11	
Rubble	med	med	high	high	124,18,11	124,78,11	11	79,11	
Cobble	high	high	high	high	124,103,18,11	124,78,11	11	79,11	
Gravel	high		low	med	124,103,18,77,11		11	79,11	
Sand	low		low	low	103,77		11	11	
Silt-Clay									
Muck (Detritus)									
Hard-pan clay	low				11				
Pelagic		low	high	high		11	11, 94	11, 94	
Cover:									
None									
Submergents	low		high		11		11		
Emergents			high				11		
Overhead									
In Situ		high	high			11	11		
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 50 Lake habitat requirements data for bull trout

Species Lake Habitat Requirements Data Sheet									
Species:	*Salvelinus confluentus* Bull trout				**Morph:**				
Habitat Features:		**Ratings[1]**				**Sources[2]**			**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	nil	low -nil	med	high	108, 104, 64	108, 104, 121, 130	108, 104, 121	108, 104, 121, 127, 106	Spawn in flowing water
Depth: (m)									
0-1		high	high	med		127	45	45, 127, 51	* depth dependent on temperatures <12°C
1-2				med				45, 127, 51	
2-5				med				45, 127, 51	
5-10				med				45, 127, 51	
10+				med				45, 127, 51	
Substrate:									
Bedrock									
Boulder			high				45		
Cobble		high	high			127	45, 127		
Rubble		high				104, 127			
Gravel		high				104, 127	127		
Sand		high				127			
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents									
Emergents									
Overhead		high	high	high		127	1, 121	127	
In Situ		high	high	high		104	1, 104, 121	121, 127	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 51 Lake habitat requirements data for brook trout

Species Lake Habitat Requirements Data Sheet									
Species:	*Salvelinus fontinalis*	Brook trout			**Morph:**				**Comments**
Habitat Features:	**Ratings**[1]				**Sources**[2]				
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	[illegible]	[illegible]	
Lake usage:	med	med	med	med	108, 116, 18, 77	108, 124, 116, 18, 78	108, 124, 116, 18	108, 124, 116, 18, 79	
Depth: (m)									
0-1	high	high	high	high	108, 124, 45, 77, 11	108, 104, 78, 11	108, 45, 11	108, 45, 79, 11	
1-2	high	high	high	high	108, 124, 45, 77, 11	108, 104, 78, 11, 109	108, 11	108, 79, 11	
2-5	low	high	high	high	45, 11	108, 124, 116, 18, 78	108, 124, 11	108, 124, 79, 11	
5-10	low	low	med	med	45, 11	124, 11	124, 11	124, 79, 11	
10+			med	med			11	11	
Substrate:									
Bedrock									
Boulder		high	high			11	11		
Cobble	med	high	high	high	11	78, 11	45, 11	45, 79, 11	
Rubble	low	high	high	high	77, 11	116, 78, 11	11	79	
Gravel	high	high	high	high	108, 124, 104, 116, 18, 77, 11	78, 11	45, 11	45, 79, 11	
Sand	med	high		low	104, 77, 11	78		79, 11	
Silt-Clay	low	med		low	104, 77, 11	78		11	
Muck (Detritus)	low				11				
Hard-pan clay	low				11				
Pelagic			low	low			11	11	
Cover:									
None									
Submergents		high	high			11	11		
Emergents		high	high	high		11	11	11	
Overhead			high	high			124	45, 116, 79, 11	
In Situ	low	high	high	high	11	116, 11	11	116, 11, 109	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 52 Lake habitat requirements data for Dolly Varden char

Species Lake Habitat Requirements Data Sheet									
Species:	*Salvelinus malma*	Dolly Varden char			**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	low	low	med	med	108, 124, 18	108, 124, 18	108, 18	108, 18	
Depth: (m)									
0-1	high	high			124, 104	124			
1-2	high	high	high	high	124	124	127	124, 127	
2-5			high	high			127	124, 127	
5-10			high	high			127	127	
10+			high	high			127	127	
Substrate:									
Bedrock	high				108				
Boulder									
Cobble		high	high			127	127		
Rubble	high	high			108	127			
Gravel	high	high	high	high	108, 124, 104	124, 127	124	124	
Sand		high				127			
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents									
Emergents									
Overhead									
In Situ	high	high	high	high		127	127	127	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 53 Lake habitat requirements data for lake trout

Species Lake Habitat Requirements Data Sheet									
Species:	*Salvelinus namaycus* Lake trout				Morph:				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	[illegible]	
Lake usage:	high	high	high	high	108, 124, 104, 45, 86, 68, 18, 77, 87, 135	108, 124, 18, 68, 78	108, 124, 18, 68, 96	108, 124, 18, 79, 87, 128	
Depth: (m)									
0-1	med	low	low	med	124, 104, 112, 90, 77	124, 78, 11	108, 18	124, 112, 18	
1-2	high	med	med	med	124, 104, 86, 44, 112, 90, 18, 77	124, 45, 18, 68, 78, 11	108, 18, 11	108, 124, 112, 18, 11	
2-5	high	high	high	med	124, 86, 44, 112, 90, 50, 18, 77	124, 50, 68, 11, 87	108, 124, 18, 68, 11	108, 124, 68, 112, 18, 11	
5-10	high	high	high	med	124, 104, 45, 86, 135, 50, 18, 77, 11	124, 90, 50, 18, 11, 96	108, 124, 104, 18, 11	108, 124, 18, 11, 128	
10+	med	high	high	high	124, 104, 90, 50, 11	50, 18, 11	108, 124, 104, 90, 112, 18, 11	108, 86, 90, 123, 112, 50, 18, 11	
Substrate:									
Bedrock	med			*	77			45, 11	*No specific substrate preferred
Boulder	med	high	high	*	124, 104, 86, 50, 77, 11	50, 78, 11	11	45, 11	
Cobble	high	high	high	*	104, 44, 112, 50, 77, 11	45, 78, 11	45, 11	45, 11	
Rubble	high	high	high	*	108, 124, 104, 45, 86, 44, 92, 112, 77, 11	45, 78, 11	45, 11	45, 123, 11	
Gravel	high	high	high	*	108, 86, 112, 77, 11	18, 78	18	45, 18, 11	
Sand	Nil	high		*	86, 50, 77, 11	78		45, 11, 87	
Silt-Clay	Nil	low	high	*	50, 11	18, 78	18	45, 18, 11	
Muck (Detritus)	Nil	med	med	*	86, 50, 11	18	18	45, 11	
Hard-pan clay		med	med	*		18	18	45, 18, 11	
Pelagic				med				45, 79, 11	
Cover:									
None	high			high	11, 135			45, 11	
Submergents									
Emergents									
Overhead									
In Situ		high	high			45, 68, 11, 96	45, 11		
Other specify?	crevices, cracks				77				
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 54 Lake habitat requirements data for Arctic grayling

Species Lake Habitat Requirements Data Sheet									
Species:	*Thymallus arcticus*	Arctic grayling			**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	*low	low	low	high	12, 40, 111	45, 61, 12, 26, 75, 111	61, 12, 40, 111	45, 12, 40, 111	* lake inlets, outlet, margins
Depth: (m)									
0-1	med	high	high	low	45, 7, 40, 111	45	40	45	
1-2	med	low	low	med	40	40	40	45, 50, 141	
2-5	med			high	40			45, 50, 141	
5-10	med			high	40			45, 50, 141	
10+	low			low	40			40	
Substrate:									
Bedrock									
Boulder		high	high	high		40	40	40	
Cobble			high		111		40		
Rubble	high	high		high	45, 103, 75	45, 75		40	
Gravel	high	high	high	high	45, 103, 40, 69, 111	45, 75	40	40	
Sand	low	low	high	low	45, 103	40	40	40	
Silt-Clay	nil	low			124	45, 75			
Muck (Detritus)	low				50, 111				
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	low			high	124			45, 50	
Emergents				high				45, 50	
Overhead									
In Situ		high	high	high		40	40	40	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 55 Lake habitat requirements data for trout-perch

Species Lake Habitat Requirements Data Sheet									
Species:	*Percopsis omiscomaycus*	Trout-perch			**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	med	high	high	med	108, 18, 77	108, 124, 18, 78	108, 124, 18	108, 124, 18, 79	
Depth: (m)									
0-1	high	high		high	124, 18, 77	18, 78	18	123, 125	
1-2	high	high		high	77	18, 78	18	123, 125	
2-5	high	high		high	77	18, 78	18	18, 79	
5-10	high			high	77			79	
10+	high			high	77			79	
Substrate:									
Bedrock									
Boulder				med				79	
Cobble			med	med			125, 18	125, 18	
Rubble	high	med	med	med	18, 77	18	125, 18	125, 18	
Gravel	high	high		high	124, 18, 77	78		18, 79	
Sand	high	high	med	high	108, 124, 18	78	125	125, 79	
Silt-Clay	high	med	low	high	77	78	125	125, 79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None			med	med			125	125	
Submergents	med		low	low	18, 77		125	125	
Emergents	med		low	low	18, 77		125	125	
Overhead									
In Situ	med	med	med	med	77	108	108	108	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 56 Lake habitat requirements data for burbot

Species Lake Habitat Requirements Data Sheet									
Species:	*Lota lota*	Burbot			**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	[illegible]	[illegible]	YOY	[illegible]	Adult	
Lake usage:	high	high	high	high	108,124,102,45,12,18,77,11	108,102,45,12,18,78,11	108, 102, 45, 34, 18, 11	108, 102, 45, 34, 18, 79, 11	
Depth: (m)									
0-1	high	high	high	low	108,124,12,88,77,11	102,45,11	124, 45, 11	124	
1-2	high	high	high	low	108,124,102,45,12,88,9,77,11	102,45,11	124, 102, 45, 11	124	
2-5	med	high	high	low	124,102,45,12,77,11	102,45,11	124, 102, 45, 11	124, 102, 45, 11	
5-10	low	low	low	high	124,102	102,45,11	124, 102, 45, 11	124, 102, 45, 79, 11	
10+	low	low	low	high		45,11	124, 45, 11	108, 124, 102, 45, 17, 11	
Substrate:									
Bedrock				high				32, 79	
Boulder	high	high	high	high	77	11	125, 11	45, 133, 32, 79	
Cobble	high	high	high	high	102,88,125,77,11	125,11	45, 9, 11	45, 79	
Rubble	high	high	high	high	88,125,77,11	102,125,78,11	45, 133, 9, 11	45, 133, 32, 79	
Gravel	high	high	high	med	102,45,88,125,11	125,78,11	45, 11	45, 79	
Sand	high	med	low	high	108,102,45,9,88,125,11	125,78,11	11	32, 79	
Silt-Clay	low			high	102,77,11			32, 79	
Muck (Detritus)	nil				11				
Hard-pan clay	nil				11				
Pelagic		high				102,88,11			
Cover:									
None	med			med	125			125	
Submergents		med	med	med		124, 102, 45, 125	124, 102, 45	32	
Emergents		med	med	med		102,125	102	133, 32	
Overhead		med	med	med		45	45	32	
In Situ		high	high	high		102, 103, 45	102,45,9	32, 9, 79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 57 Lake habitat requirements data for brook stickleback

Species Lake Habitat Requirements Data Sheet									
Species:	Culaea inconstans brook stickleback				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 124, 18, 7	108, 124, 18, 78		108, 124, 18, 79	
Depth: (m)									
0-1	high	high		high	108, 77	78		79	Sexual maturity is generally attained in one year, therefore a distinct category for the juvenile life history is not required.
1-2		high		high		78		79	
2-5		high		high		78		79	
5-10		high		high		78		79	
10+				high				79	
Substrate:									
Bedrock									
Boulder									
Cobble		med		med		125, 78		125	
Rubble				med				125	*use of vegetation regardless of substrate
Gravel		high		high	77	125, 78		125, 79	
Sand		med		high	77	125, 78		125, 79	
Silt-Clay		med		high	77	125, 78		125, 79	
Muck (Detritus)					124				
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high	high		high	108, 77	108, 125, 78		108, 125, 79	
Emergents	high	high		high	108, 124, 77	108, 125		108, 125	
Overhead	high				108				
In Situ	med	med		med	108, 77	125		125, 79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 58 Lake habitat requirements data for threespine stickleback

Species Lake Habitat Requirements Data Sheet									
Species:	*Gasterosteus aculeatus* Threespine stickleback				**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 18, 77	108, 18, 78	108, 18	108, 18, 77, 11	
Depth: (m)									
0-1	high	high	high	high	124, 77, 11	78, 11	11	11	
1-2	high	high	high	high	124, 11	78, 11	11	11	
2-5	low	high		high	124, 11	78, 11		11	
5-10	low	med		high	11	78, 11		11	
10+	low	med		low	11	78, 11		11	
Substrate:									
Bedrock									
Boulder									
Cobble	low			low	11			11	
Rubble	low			low	11			11	
Gravel	med	high		med	77, 11	78		79, 11	
Sand	high			low	124, 77, 11			79, 11	
Silt-Clay	high			high	77, 11			79, 11	
Muck (Detritus)	high			high	124, 11			11	
Hard-pan clay	high	low	low	high	11	11	11	11	
Pelagic				high				11	
Cover:									
None	med	low	low	low	11	28	28	28	
Submergents	med	low	med	med	124, 77, 11	78	28	79	
Emergents	med	high	high	med	77, 11	11	11	79, 11	
Overhead		high	high	high		11	11	11	
In Situ				high				11	
Other specify?				high				11	
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 59 Lake habitat requirements data for ninespine stickleback

Species Lake Habitat Requirements Data Sheet									
Species:	*Pungitius pungitius*	Ninespine stickleback			**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 124, 18, 77	108, 124, 18, 78	108, 124, 18	108, 124, 18, 79	
Depth: (m)									
0-1	high	high	high	high	77, 11	78, 11	11	79, 11	
1-2	low	high	high	high	77, 11	78, 11	11	79, 11	
2-5	low	high	high	high	77, 11	78, 11	11	79, 11	
5-10	low	med	high	high	77, 11	78, 11	11	79, 11	
10+	low	med	high	high	11	78, 11	108, 11	108, 79, 11	
Substrate:									
Bedrock									
Boulder									
Cobble	med		high	high	77, 11		125	125, 11	
Rubble	high	high	high	high	77, 11	78	125	125, 11	
Gravel	med		low	low	77, 11		125	125, 79, 11	
Sand	med	low	high	high	77, 11	11	125	125, 79, 11	
Silt-Clay	med	high	high	high	77, 11	11	125	125, 79, 11	
Muck (Detritus)	high	high			11	11			
Hard-pan clay	high	high		high	11	11		11	
Pelagic				med				108	
Cover:									
None	low	low	med	low	11	11	125	11	
Submergents	high	high	med	med	77, 11	78, 11	125	108, 11	
Emergents	high	high	med	med	77, 11	11	125	108, 11	
Overhead									
In Situ			med	med			125	125	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 60 Lake habitat requirements data for mottled sculpin

Species Lake Habitat Requirements Data Sheet									
Species:	*Cottus bairdi*	Mottled sculpin			**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			**Comments**
Categories	**Spawn/Emb**	**YOY**	**Juvenile**	**Adult**	**Spawn/Emb**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	med	med		med		78		79	
Depth: (m)									
0-1	high	high	high	high	77, 11	11	11	11	
1-2		high		high		78		79	
2-5									
5-10		high				78			
10+									
Substrate:									
Bedrock									
Boulder	high	high	high	high	11	78, 11	11	11	
Cobble	high	high			77	78			
Rubble	high	high	high	med	11	78, 11	11	79, 11	
Gravel	high	med		high	77	78		79	
Sand	high	med	high	high	124, 11	124, 78, 11	124, 11	124, 79, 11	
Silt-Clay	high			med	11			79	
Muck (Detritus)									
Hard-pan clay		high							
Pelagic									
Cover:									
None									
Submergents		low		med		78		79	
Emergents		low				78			
Overhead									
In Situ	high	high	high	high	77	78	11	79, 11	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.
[2] Sources are numbered and reflect sources found in the numbered references.

Table 61 Lake habitat requirements data for slimy sculpin

Species Lake Habitat Requirements Data Sheet									
Species:	*Cottus cognatus*	Slimy sculpin			**Morph:**				
Habitat Features:	**Ratings[1]**				**Sources[2]**				**Comments**
Categories	**Spawn/Egg**	**YOY/Larval**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY/Larval**	**Juvenile**	**Adult**	
Lake usage:	med	med	high	high	108, 124, 77	108, 124, 78	108, 124	108, 124, 79	
Depth: (m)									
0-1	high	high	high	low	124, 77, 11	124, 78	11	124, 79	
1-2	high	high	high	high	124, 77	124, 78	11	79, 11	
2-5	med	med	med	high	124, 77, 11	124	11	79, 11	
5-10	nil	med	med	high	124, 11	11	11	124, 79, 11	
10+	nil			high	124, 11			124, 79, 11	
Substrate:									
Bedrock				med				79	
Boulder	high	high	high	med	77	78		79	
Cobble	high	high	high	med	77	78		79	
Rubble	high	high	med	high	77	11	11	79	
Gravel	high	med	med	high	124, 103, 77, 11	103, 78, 11	11	79	
Sand	med	med	med	high	124, 103, 77, 11	78, 11	11	79	
Silt-Clay	low			med	77			79	
Muck (Detritus)	-	-	-	-					
Hard-pan clay	-	high	-	-		78			
Pelagic	-	-	-	-					
Cover:									
None									
Submergents									
Emergents									
Overhead									
In Situ	high	high	high	high	124, 77, 11	108, 78	108	108, 79	
Other specify?									
Other specify?	-	-	-	-					

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 62 Lake habitat requirements data for spoonhead sculpin

Species Lake Habitat Requirements Data Sheet									
Species:	*Cottus ricei*	Spoonhead sculpin			**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	108, 124	108, 124	108, 124	108, 124	
Depth: (m)									
0-1									
1-2	med	med	med	med	124	124	124	124, 79	
2-5	med			med	77			79	
5-10	med	med	med	med	124	124	124	124, 79	
10+	med	med	med	med	124	124	124	124, 79	
Substrate:									
Bedrock	high				77				
Boulder	high	high		med	108, 77	108, 78		79	
Cobble	high	high		med	77	78		79	
Rubble	high	high		med	77	108, 78		79	
Gravel	low			med	77			79	
Sand				med				79	
Silt-Clay				low				79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents				low				79	
Emergents				low				79	
Overhead									
In Situ	low			med	77			79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 63 Lake habitat requirements data for deepwater sculpin

Species Lake Habitat Requirements Data Sheet									
Species:	*Myoxocephalus thompsoni*		Deepwater sculpin		**Morph:**				
Habitat Features	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage	high	high	high	high	108, 124	108, 124	108, 124	108, 124	
Depth: (m)									
0-1		med				124, 78			
1-2		med				124, 78			
2-5		med				124, 78			
5-10		med				124, 78			
10+	high	high	high	high	77	124, 78	124	124, 79	
Substrate:									
Bedrock	high				77				
Boulder	high	high		med	77	78		79	
Cobble	high	high		med	77	78		79	
Rubble	low			med	77			79	
Gravel				med				79	
Sand				med				79	
Silt-Clay	high			med	77			79	
Muck (Detritus)									
Hard-pan clay	high			low	77			79	
Pelagic									
Cover:									
None									
Submergents				low				79	
Emergents				low				79	
Overhead									
In Situ				med				79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 64 Lake habitat requirements data for rock bass

Species Lake Habitat Requirements Data Sheet									
Species:	*Ambloplites rupestris*	Rock bass			**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	124, 77	124, 78	124	124, 79	
Depth: (m)									
0-1	med	high	high	bhigh	77	124, 78	124	124, 79	
1-2	med	high	high	dhigh	77	124, 78	124	124, 79	
2-5		high				124, 78			
5-10									
10+									
Substrate:									
Bedrock				med				79	
Boulder				med				79	
Cobble	high	med	high	high	77	124	124	124, 79	*prefer substrate strongly associated with vegetation
Rubble	high	med	high	high	77	124, 78	124	124, 79	
Gravel	high	high	high	high	124, 77	124, 78	124	124, 79	
Sand	med	high	high	med	77			79	
Silt-Clay	med	high	high	med	77	60, 78	60	60, 79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	low	high	high	high	77	78	124	79	
Emergents	low				77				
Overhead									
In Situ	high			high	77			79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 65 Lake habitat requirements data for pumpkinseed

Species Lake Habitat Requirements Data Sheet									
Species:	*Lepomis gibbosus*	Pumpkinseed			**Morph:**				
Habitat Features:		**Ratings[1]**				**Sources[2]**			**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	124, 77, 81	124, 78	124	124, 81	
Depth: (m)									
0-1	high	high		high	124, 77	78		79	
1-2	high	high		high	77	78		79	
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble	high			low	124			79	
Gravel	high			med	124, 77			79	
Sand	high	high		high	124, 77	78		79	
Silt-Clay	med	high		high	124, 77	78		79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high	high	high	high	124	124, 78	124	124, 79	
Emergents	high	high		high	77	78		79	
Overhead		high	high	high		124	124	124	
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 66 Lake habitat requirements data for smallmouth bass

Species Lake Habitat Requirements Data Sheet									
Species:	*Micropterus dolomieu*	Smallmouth bass		**Morph:**					
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	124, 77	124, 78	124	124, 79	
Depth: (m)									
0-1	med	high	high	high	124, 77	78	124	124, 79	
1-2	med	high	high	high	124, 77	78	124	124, 79	
2-5	med	high	high	high	124	78	124	124, 79	
5-10	med	high	high	high	124	78	124	124, 79	
10+									
Substrate:									
Bedrock	med	med			77	78			
Boulder		high		high		78		79	
Cobble	high	high	high	high	124, 77	78	124	124, 79	
Rubble	high	high	high	high	124, 77	78	124	124, 79	
Gravel	med	med	high	high	124	78	124	124, 79	
Sand	med	med	low	low	124, 77	78	124	124, 79	
Silt-Clay		low				78			
Muck (Detritus)									
Hard-pan clay				med				79	
Pelagic									
Cover:									
None									
Submergents	low	low	low	low	124, 77	124, 78	124	124, 79	
Emergents	low	low	low	low	124, 77	124, 78	124	124, 79	
Overhead									
In Situ	med	med	med	med	124, 77	124, 78	124	124, 79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 67 Lake habitat requirements data for largemouth bass

Species Lake Habitat Requirements Data Sheet									
Species:	*Micropterus salmoides* Largemouth bass				Morpho[illegible]				
Habitat Features:	[illegible] Rating¹				Sources²				Comments
Categories	Spawn[illegible]	YOY	Juvenile	Adult	[illegible]	[illegible] YOY	[illegible]	[illegible]	
Lake usage	high	high	high	high	124, 134, 114, 77	124, 134, 78	124, 134	124, 134, 79	
Depth: (m)									
0-1	med	high	high	high	124, 134, 77	124, 114, 78	124, 134, 114	124, 134, 114, 79	
1-2	high	high	high	high	124, 134, 77	124, 114, 78	124, 134, 114	124, 134, 114, 79	
2-5	high	high	high	high	124, 134	114, 78	134	134, 79	
5-10	med	med	med	med	134	124	124, 134	124, 134, 79	
10+									
Substrate:									
Bedrock									
Boulder	low	low	low	low	134	124	124	124	
Cobble									
Rubble	low	low	low	low	77	124	124	124	
Gravel	high		low	low	134, 77		134	134, 79	
Sand	med	med	high	high	124, 134, 77	134, 114, 78	134, 114	134, 114, 79	* Primarily associated with vegetation
Silt-Clay	high	high	med	med	134, 77	124, 134, 114, 78	124, 134, 114	124, 134, 114, 79	
Muck (Detritus)	med				124, 134				
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	med	high	high	high	124, 77	124, 114, 78	124, 114	124, 134, 114, 79	
Emergents	high	high	high	high	124, 77	124, 134, 114, 78	124, 114	124, 134, 114, 79	
Overhead									
In Situ	med	med	med	med	124	124, 114	124, 114	124, 114	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 68 Lake habitat requirements data for black crappie

Species Lake Habitat Requirements Data Sheet									
Species:	*Pomoxis nigromaculatus* Black crappie				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	high	high	high	high	77	124, 78	124	124, 79	
Depth: (m)									
0-1	high	high	high	high	124, 113, 77	113	124, 113	124, 113, 79	
1-2	high	high	high	high	77		124	124, 79	
2-5	high	high	high	high	77		113	113, 79	
5-10									
10+									
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble				low				79	
Gravel	high			high	124, 77			79	*various substrates associated with vegetation utilised
Sand	high	high	high	high	124, 77	124, 60, 78	124, 60	124, 60, 79	
Silt-Clay	high	high	high	high	77	60, 78	60	60, 79	
Muck (Detritus)	high	high	high	high	124	124	124	124	
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	high	high	high	high	124, 113, 60, 77	124, 113, 60, 78	124, 113, 60	124, 113, 60, 79	
Emergents	high	high	high	high	124, 113, 60, 77	124, 113, 60, 78	124, 113, 60	124, 113, 60, 79	
Overhead	med			high	124			113	
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 69 Lake habitat requirements data for Iowa darter

Species Lake Habitat Requirements Data Sheet									
Species:	*Etheostoma exile*	Iowa Darter			**Morph:**				
Habitat Features:	**Ratings**[1]				**Sources**[2]				**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	med	med	high	high	108, 77	108, 78	108	108	
Depth: (m)									
0-1	high	high	high	high	77	108, 78	108, 124	108, 79	
1-2		high	high	high		108, 78	108, 124	108, 79	
2-5		high	high	high		108, 78	108, 124	108, 79	
5-10				high				108, 124	
10+									
Substrate:									
Bedrock									
Boulder									
Cobble	high		med	med	108, 124		125	125	
Rubble	high		high	high	108, 77		125	125	
Gravel	high	high	low	high	108, 77	78	125	125, 79	
Sand	high	high	med	high	77	78	125	125, 79	
Silt-Clay	high	high	med	high	77	78	125	125, 79	
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None			low	low			125	125	
Submergents	med	med	high	med	77	78	108, 125	108, 125, 79	
Emergents	med		med	med	77		108, 125	108, 125	
Overhead	med				124, 77				
In Situ	high		med	med	108		125	125	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 70 Lake habitat requirements data for Johnny darter

Species Lake Habitat Requirements Data Sheet									
Species:	*Etheostoma nigrum*	Johnny darter			**Morph:**				
Habitat Features	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage	med	high	high	med	124, 18, 77	124, 18, 78	124, 18	124, 18, 79	
Depth: (m)									
0-1	med	high	med	high	77	114, 78	114	114, 79	
1-2		high		high		78		79	
2-5		high	high	high		78	18	79	
5-10			high	high			124, 18	124, 79	
10+			high	high			124, 18	124, 18, 79	
Substrate:									
Bedrock									
Boulder									
Cobble	med				77				
Rubble	med			med	77	18	18	18, 79	
Gravel	high	high		high	124, 77	124, 18, 114, 78	18, 114	124, 18, 114, 79	
Sand	high	high	high	high	124, 77	124, 114, 78	124, 114	124, 114, 79	
Silt-Clay	med	high	high	high	124, 77	124, 114, 78	124, 114	124, 114, 79	
Muck (Detritus)		med	med	med		18	18	18	
Hard-pan clay									
Pelagic									
Cover:									
None		med	med	med		114	114	114	
Submergents		med	med	med		124, 18, 78	124, 18	124, 18, 79	
Emergents		med	med	med		124, 18	124, 18	124, 18, 79	
Overhead									
In Situ	high			high	124, 77			79	
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 71 Lake habitat requirements data for yellow perch

Species Lake Habitat Requirements Data Sheet									
Species:	*Perca flavescens* Yellow perch				**Morph:**				
Habitat Features:		**Ratings**[1]				**Sources**[2]			**Comments**
Categories	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	**Spawn/Egg**	**YOY**	**Juvenile**	**Adult**	
Lake usage:	high	high	high	high	108, 124, 77	108, 124, 78	108, 124, 81	108, 124, 79	
Depth: (m)									
0-1	high	high	high	high	76, 142	78	124	79	
1-2	high	high	high	high	76, 142	78	124	79	
2-5	high	high	high	high	76, 142	78	124	79	
5-10	high	high	high	high	77	78	124	79	
10+			low	low			124	79	
Substrate:									
Bedrock				low				79	
Boulder				low				79	
Cobble			med	low			125	79	
Rubble	low		med	med	142, 77		125	125, 79	
Gravel	med	high	med	high	124, 76, 142, 77	124, 78	124, 125	124, 79	
Sand	med	high	med	high	124, 125, 142, 77	124, 78	124, 125	124, 125, 79	
Silt-Clay	low	high	med	high	77	78	125	125, 79	
Muck (Detritus)		high	high	high		124	124	124	
Hard-pan clay									
Pelagic		high	high	high		124	124	124	
Cover:									
None			med	med			125	125	
Submergents	high	high	high	high	124, 76, 19, 142	124, 78	124	124, 76, 79	
Emergents	med	med	med	med	142, 77	78	125	125, 79	
Overhead	med				124				
In Situ	med		med		19, 125, 77		125		
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 72 Lake habitat requirements data for logperch

Species Lake Habitat Requirements Data Sheet									
Species:	*Percina caprodes* Logperch				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	108, 124, 77	108, 124, 78	108, 124	108, 124, 79	
Depth: (m)									
0-1	high	ahigh		high	108, 77	124, 78		124, 79	
1-2	high	high	high	high	77	108, 124, 78	108, 124	108, 124	
2-5		high	high	high		108, 124	108, 124	108, 124	
5-10		chigh	high	high		108, 124, 78	108, 124	108, 124	
10+			high	high			124	124, 79	
Substrate:									
Bedrock									
Boulder	med			low	77			79	
Cobble	med			med	77			79	
Rubble	high	med	med	med	77	124, 78	124	124, 79	
Gravel	high	high	high	high	77	124, 78	124	124, 79	
Sand	high	high	high	high	124, 77	124, 78	124	124, 79	
Silt-Clay		med				78			
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents		med		med		78		79	
Emergents		med				78			
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 73 Lake habitat requirements data for blackside darter

Species Lake Habitat Requirements Data Sheet									
Species:	*Percina maculata*		Blackside darter		**Morph:**				
Habitat Features:		Ratings[1]				Sources[2]			Comments
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	low	low	low	low	124, 77	124, 78	124	124, 79	
Depth: (m)									
0-1	high	high	high	high	124, 77	78	124	124, 79	
1-2		high				78			
2-5									
5-10									
10+									
Substrate:									
Bedrock									
Boulder				high				79	
Cobble									
Rubble				low				79	
Gravel	high	high	high	high	124, 77	78	124	79	
Sand	high	high	high	high	124, 77	78	124	79	
Silt-Clay		low	low	low		78	124	79	
Muck (Detritus)									
Hardpan clay									
Pelagic									
Cover:									
None									
Submergents		med		low		78		79	
Emergents		med		low		78		79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 74 Lake habitat requirements data for river darter

Species Lake Habitat Requirements Data Sheet									
Species:	*Percina shumardi*	River darter			**Morph:**				
Habitat Features:	[illegible]	Ratings[1]			[illegible]	Sources[2]			**Comments**
Categories:	[illegible]	[illegible]	[illegible]	[illegible]	Spawn/E[illegible]	YOY	[illegible]	[illegible]	
Lake usage:	low	med	med	med	124, 77	124, 78	124	124, 79	
Depth: (m)									
0-1	high	high	high	high	77	78	124	124, 79	
1-2		high	high	high		78	124	124, 79	
2-5									
5-10									
10+									
Substrate:									
Bedrock	med			low	77			79	
Boulder	med	med	med	med	124, 77	124	124	124, 79	
Cobble	med			low	77			79	
Rubble	high	high	high	high	124, 77	124	124	124, 79	
Gravel	high	high	high	high	124, 77	124	124	124, 79	
Sand		high		high		78		79	
Silt-Clay									
Muck (Detritus)									
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents									
Emergents									
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 75 Lake habitat requirements data for sauger

Species Lake Habitat Requirements Data Sheet									
Species:	*Stizostedion canadense* Sauger				**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	high	high	high	124, 12, 77	124, 78	124	124, 79	
Depth: (m)									
0-1	med			high	124, 12, 19, 77			124, 79	
1-2	med	high		high	124, 19, 77	78		124, 79	
2-5	med	high		high	124, 115, 19, 77	78		124, 79	
5-10		high		high		78		79	
10+									
Substrate:									
Bedrock									
Boulder	med				124, 77				
Cobble	high				124, 115, 77				
Rubble	high				124, 19, 77				
Gravel	high	high		low	124, 115, 19, 77	78		79	
Sand	med	high		med	115, 19, 77	78		79	
Silt-Clay	low	low		med	77	78		79	
Muck (Detritus)		med				115			
Hard-pan clay									
Pelagic									
Cover:									
None									
Submergents	low	-		low	77			79	
Emergents	low	-		low	77			79	
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 76 Lake habitat requirements data for walleye

Species Lake Habitat Requirements Data Sheet									
Species:	*Stizostedion vitreum* Walleye				Morph[illegible]				
Habitat Features:	Ratings[1]				Sources[2]				Comments
Categories	Spawn/Egg	YOY	[illegible]	[illegible]	[illegible]	[illegible] YOY [illegible]	[illegible]	[illegible]	
Lake usage	high	high	high	high	108, 124, 45, 119, 54, 38, 144, 77	108, 124, 24, 144, 78	108, 124, 45, 144	108, 124, 144, 79	
Depth: (m)									
0-1	med	high	high	high	124, 45, 87, 19, 24, 54, 38, 77	124, 144, 24, 38, 78	124, 100, 24, 144	124, 45, 24, 143, 144, 79	
1-2	high	high	high	high	124, 45, 87, 24, 80, 54, 38, 77	124, 24, 115, 144, 78	124, 100, 24, 144	124, 45, 24, 143, 144, 79	
2-5	high	high	high	high	45, 24, 80, 54, 77	124, 24, 144, 78	124, 100, 24, 144	124, 45, 24, 143, 144, 79	
5-10	high	high	high	high	45, 24, 80, 54, 77	124, 24, 78	100, 24	45, 24, 143, 79	
10+			high	high			124, 100, 24	124, 45, 100, 143	
Substrate:									
Bedrock	low			med	77			24	
Boulder	med		med	med	124, 54, 38, 77		100	24, 79	
Cobble	high		med	med	100, 125, 54, 38, 77		100	45, 125, 79	
Rubble	high		high	high	124, 45, 100, 87, 19, 125, 12, 46, 77	38	100	125, 79	
Gravel	high	high	high	high	124, 45, 100, 19, 87, 24, 54, 38, 4, 46, 77	78	100	45, 79	
Sand	med	high	high	high	80, 24, 54, 38, 4,19, 77	38, 78	100	125, 79	
Silt-Clay	low	high	med	high	125, 24	80	100	125, 66, 68, 79	
Muck (Detritus)	low	high		high	4, 80	80		66, 68	
Hard-pan clay	low	high	low	low	77	78	100	79	
Pelagic		med		low		124		143	
Cover:									
None	med		med	med	125		100	125	
Submergents	low	low	low	low	124, 77	78	100	45, 79	
Emergents	low	low	low	low	124, 19, 125, 77	78	100	125, 79	
Overhead			high	high			45	45, 24, 143	
In Situ	high		med	high	45		45, 100	45, 24, 143, 79	
Other specify?			turbidity	turbidity			100, 91	100, 91	
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 77 Lake habitat requirements data for freshwater drum

Species Lake Habitat Requirements Data Sheet									
Species:	*Aplodinotus grunniens*		Freshwater drum		**Morph:**				
Habitat Features:	Ratings[1]				Sources[2]				**Comments**
Categories	Spawn/Egg	YOY	Juvenile	Adult	Spawn/Egg	YOY	Juvenile	Adult	
Lake usage:	med	med	med	med	124, 114	124, 114	124, 114	124, 114	
Depth: (m)									
0-1	med	med	med	high	124	124	124	114	
1-2	med	med	med	high	124	124	124	124	
2-5			med	high			124	124	
5-10			med	high			124	124	
10+			med	high			124	124	
Substrate:									
Bedrock									
Boulder									
Cobble									
Rubble									
Gravel				high				114	
Sand	med		high	high	124		114	114	
Silt-Clay	med	high	high	high	124	114	114	114	
Muck (Detritus)	med				124				
Hard-pan clay									
Pelagic									
Cover:									
None			high	high			114	114	
Submergents									
Emergents									
Overhead									
In Situ									
Other specify?									
Other specify?									

[1] Ratings are nil (default), low, medium or high.

[2] Sources are numbered and reflect sources found in the numbered references.

Table 78 Species for which there are no available lake habitat requirements data or that are limited in distribution in the Prairie Region

Scientific Name **Petromyzontidae**	**Common Name** **Lamprey**	**Comments and Observations**	**Sources**
Ichthyomyzon castaneus	Chestnut lamprey	This species is known to utilise stream habitat. There is no information in the literature reviewed on lake habitat use.	108, 124
Ichthyomyzon fossor	Northern brook lamprey	Native in the Whitemouth River. Lake usage for any life stage was not found in the reviewed literature.	132
Cyprinidae	**Carp and Minnow**		
Carassius auratus	Goldfish	Illegal releases of goldfish have established several self sustaining populations in both lakes and ponds but little information is available on habitat use.	108, 124
Hybognathus argyritis	Western silvery minnow	There was no information in the literature reviewed on lake habitat use by western silvery minnow in the Prairie Provinces.	
Nocomis biguttatus	Hornyhead chub	There was no information in the literature reviewed on lake habitat use by horneyhead chub in the Prairie Provinces.	
Notropis blennius	River shiner	There was no information in the literature reviewed on lake habitat use by river shiner in the Prairie Provinces.	
Notropis dorsalis	Bigmouth shiner	This species is rarely associated with lakes, thus there was no information in the literature reviewed on lake use by bigmouth shiner in the Prairie Provinces.	18
Notropis rubellus	Rosyface shiner	There was no information in the literature reviewed on lake habitat use by rosyface shiner in the Prairie Provinces.	
Cyprinella spiloptera	Spotfin shiner	There was no information in the literature reviewed on lake habitat use by spotfin shiner in the Prairie Provinces.	
Notropis volucellus	Mimic shiner	Although observed in lakes in eastern regions of Canada, limited lake habitat information exists for this species in the Prairie Provinces.	108, 124
Notropis texanus	Weed shiner	There was no information in the literature reviewed on lake habitat use by weed shiner in the Prairie Provinces. However, there are observations for this species in Lake Dauphin, Manitoba .	132
Pimephales notatus	Bluntnose minnow	There was no information in the literature reviewed on lake habitat use by bluntnose minnow in the Prairie Provinces.	
Ptychocheilus oregonensis	Northern pikeminnow (Northern squawfish)	On the western side of the rocky mountains, this species primarily inhabits lakes; however, in the Prairies, they are known only in the Peace River system.	108, 124
Rhinichthys atratulus	Blacknose dace	This species is rarely associated with lakes. Hybrid specimens where found in Lake Minnewanka, but no actual blacknose dace. They do exist in the Saskatchewan River drainage in Saskatchewan and Manitoba.	108, 137, 18

Table 78 Species for which there are no available lake habitat requirements data or that are limited in distribution in the Prairie Region Continued

Scientific Name	**Common Name**	**Comments and Observations**	**Sources**
Catostomidae	**Sucker**		
Catostomus macrocheilus	Largescale sucker	Largescale sucker are found in rivers and deep lakes within their distribution range. However, in Alberta, they are found only in the Upper reaches of the Peace River system, and only in rivers. This species does not occur any other Prairie Provinces.	108, 124
Catostomus platyrhynchus	Mountain sucker	There was no information in the literature reviewed on lake habitat use by mountain sucker in the Prairie Provinces.	
Moxostoma erythrurum	Golden redhorse	There was little information in the literature reviewed on lake habitat use by golden redhorse in the Prairie Provinces. This species is mainly riverine; however there is one record from Lake Winnipeg.	132
Ictaluridae	**Bullhead catfish**		
Noturus flavus	Stonecat	There was no information in the literature reviewed on lake habitat use by stonecat in the Prairie Provinces.	
Salmonidae	**Trout**		
Coregonus nigripinnis	Blackfin cisco	There was no information in the literature reviewed on lake habitat use by blackfin cisco in the Prairie Provinces.	
Oncorhynchus kisutch	Coho salmon	Coho salmon inhabit lakes west of the Rocky Mountains, but there are no known self sustaining populations exist in the Prairie Provinces. Spawning occurs in the spr	108, 124, 99
Oncorhynchus nerka	Kokanee/Sockeye salmon	Kokanee inhabit lakes west of the Rocky Mountains, but no known self sustaining populations exist in the Prairie Provinces. One population was introduced into Duck Mountain Provincial Park in Manitoba, but its self-sustainability remains unknown.	108, 132, 124, 126
	Splake	Splake are the hybrid brood of female lake trout and male brook trout. Lake Agnes, near Lake Louise, Alberta, has a self sustaining splake population.	108, 124
Osermeridae	**Smelt**		
Osmerus mordax	Rainbow smelt	One recorded observation in the Red River. Recently introduced into Lake Winnipeg drainage; however habitat use and population status remains unknown.	132

Table 78 Species for which there are no available lake habitat requirements data or that are limited in distribution in the Prairie Region Continued

Scientific Name	Common Name	Comments and Observations	Sources
Cyprinodontidae	**Killifish**		
Fundulus diaphanus	Banded killifish	Only two reported observation of this species in the Manitoba, one in the Red River and one in the Winnipeg River. There was no information in the literature reviewed on lake use by banded killifish in the Prairie Provinces.	108, 124
Serranidae	**Sea Bass**		
Morone chrysops	White bass	This species is frequently associated with lakes; however, in the Prairie Provinces, there have been very few recorded observations of this species in Lake Winnipeg.	124, 56, 77
Cottidae	**Sculpin**		
Cottus asper	Prickly sculpin	There was no information in the literature reviewed on lake habitat use by prickly sculpin in the Prairie Provinces.	
Cottus confusus	Shorthead sculpin	There was no information in the literature reviewed on lake habitat use by shorthead sculpin in the Prairie Provinces.	
Centrarchidae	**Sunfish**		
Lepomis macrochirus	Bluegill sunfish	Introduced and rare in the Red River drainage and Winnipeg River drainage in Whiteshell Provincial Park.	132
Pomoxis annularis	White crappie	Introduced and rare in the Red River drainage.	132

Appendix I – Glossary of terms

adhesive – sticking or clinging.

adult – life stage of fish where they have matured and are able to reproduce.

aquatic plants – plants whose photosynthetically active parts are permanently, or at least for several months each year, submerged in, or floating on, fresh water.

alevin – a stage of embryonic development of salmonid fish species that refers to fish recently hatched from the egg and before the absorption of the yolk sac and emergence from spawning gravel.

alloptric – species inhabiting geographically separated areas from other stocks of the same species.

ammocete – a name applied to the larval form of lampreys.

anadromous – fish which breed in fresh water but spend most of their adult life at sea; also commonly referred to as sea-run.

aquatic – living in (freshwater, estuarine or marine).

benthic – living on or near the bottom of aquatic habitats.

benthos – organisms, both plant and animal, that inhabit the bottom substrates (sediments, debris, logs, macrophytes) of aquatic habitats for at least part of their life cycle.

cover – features within the aquatic environment that may be used by fish for protection (or refuge) from predators, competitors and adverse environmental conditions.

demersal – living on or near the bottom of a lake; often said of fishes and fish eggs.

depth – distance from the lake bottom to the water surface.

detritus – organic material from dead organisms, plant and animal.

diadromous – pertaining to fishes that migrate between fresh and salt water.

dissolved oxygen – atmospheric oxygen that has been absorbed by water and upon which fish and other aquatic organisms depend for respiration; usually expressed in parts per million (ppm) of water.

embryo – an organism in its earliest stage of development, before emergence from the egg.

emergent vegetation – aquatic plants which grow on water-saturated or submerged soils and extend their stems and leaves above the surface of the water (e.g., cattails, grasses, sedges, and rushes).

epibenthic – living on or near the bottom of aquatic habitats; often said of fishes.

epilimnion – the upper, well-mixed, well-illuminated, nearly isothermal region of a stratified lake characterized by fairly turbulent water; usually rich in oxygen.

escapement – fish originally occurred under hatchery conditions and is now established in the wild.

estuary – a semi-enclosed body of water which has a free connection with the open ocean and within which seawater is measurably diluted with fresh water derived from land drainage.

eutrophy – condition of water being rich in plant nutrients.

exotic species – any fish species that does no t occur naturally within the geographic range to which it is being introduced.

fingerling – young fish, usually late in the first year.

fish habitat – spawning grounds and nursery, rearing, food supply and migration areas on which fish depend either directly or indirectly in order to carry out their life processes.

fry – the life stage of fish, after the yolk sac has been absorbed.

groundwater – water present below the surface of the ground; important in lake-spawning site selection for some species of salmonids (e.g., brook trout).

hybrid – the offspring of parents of different species. Hybrids are generally infertile or have reduced viability, and reproduction is minimal.

hypolimnion – the poorly illuminated lower region of a stratified lake characterized by denser, colder water protected from wind action; lies below the metalimnion and overlies the profundal zone.

in situ cover – refers to cover on the bottom of a lake or in the water column which provides refugia and feeding surfaces; includes large rocks and boulders on a sand-gravel substrate.

incubation period – the time interval between egg laying and hatching.

indigenous species – any naturally occurring fish species of native or local origination (*i.e.*, not imported or introduced).

isotherm – a line joining points of equal temperature.

juvenile – young fish, fundamentally like adults in appearance, but smaller and reproductively inactive.

lacustrine habitat – refers to habitat contained in pond or lake areas.

landlocked – refers to fish species that are prevented from making return migrations to the sea because of natural obstructions. It also categorizes fish that live entire life cycle in freshwater regardless of whether they have access to the sea.

larvae – organisms which at birth or hatching are fundamentally unlike their parents and must pass through metamorphosis before assuming adult characteristics.

lentic – refers to standing water, as in ponds and lakes.

littoral – refers to the marginal region of a body of water and is usually defined by the band from zero depth to the outer edge of rooted plants; shallow, nearshore region. These areas are subject to fluctuating water temperature and erosion of shore material through wave action and the grinding of ice and are usually well lighted.

macrophytes – another term for rooted aquatic plants.

metalimnion – the central stratum between the epilimnion and hypolimnion in a stratified lake where water temperature drops at least 1°C with every 1 m decrease in depth; the region occupied by the thermocline.

metamorphosis – change in form and structure which fish undergo from the embryo to adult stage.

migration – the deliberate movement of fish from one habitat to another.

natal river – refers to a fish's river of origin (at birth).

native species – fish that originate in the area in which they live (refer to indigenous species).

nursery (rearing) habitat – generally refers to the portion of fish habitat that provides food and cover for young fish.

oligotrophy – condition of water being poor in plant nutrients; characteristic of well-oxygenated lakes.

ontogenetic – refers to size-related shifts or life history changes that occur during the growth and development of an individual.

organic – derived from a living organism.

organic debris – refers to all material in a water course that is of organic origin including algae, aquatic plants, logs, tress, and other woody material.

overhanging (riparian) cover – refers to cover provided by vegetation such as grasses, shrubs, alders and other low story tress adjacent to the waterbody up to 1 m above the water surface.

overhead cover – refers to riparian cover overhanging littoral habitat, undercut banks, woody debris at the surface providing shade, crevices, etc.

parr – juvenile stage in the life cycle of the salmonids from redd dispersal to migration to salt water. Parr are distinguishable by the dark vertical bars (parr marks) along the body.

pelagic (limnetic) – refers to open-water regions, either middle or surface water levels, that are not directly influenced by the shore or bottom.

piscivorous – fish-eating.

plankton – small aquatic plants and animals, sometimes microscopic, drifting with the surrounding water.

population – a group of individuals of a species occupying the same waters during at least part of their life cycle.

profundal – refers to the deep, cold region of lakes where currents are at a minimum and where light is much reduced; comprises the deep water and the lake bottom.

redd – the gravel nest of salmonid fishes where eggs are deposited.

resident fish – fish which remain in freshwater throughout their entire life cycle (non-anadromous).

shoals – refers to areas near the mouths of streams where the stream meets the slower water of a pond or lake.

slit – very fine sediment particles that can be carried or moved by stream velocities and deposited in slower moving waters. This material can be particularly harmful to invertebrates and extremely detrimental to the quality of fish habitat, especially spawning gravel.

smolt – a 2 or more year old juvenile salmonid having undergone physiological changes to cope with a marine environment; usually refers to salmonids exhibiting silvery coloration and downstream movement to sea.

spawning habitat – refers to habitat used by reproductively active fish for spawning and incubation of fertilized eggs.

sublittoral – below littoral; usually refers to the bottom region of a lake, lying between the littoral and the profundal zones where it is too deep for rooted plants to grow.

submergent vegetation – aquatic plants that grow entirely below the water's surface (e.g., elodea, pondweeds, bladderwort, and pipewort), and include numerous mosses and macroalgae.

substrate – the materials of which the lake bottom is comprised including: bedrock, boulder, rubble, cobble, gravel, sand, silt, detritus, and mud.

sympatric – species inhabiting the same or overlapping geographic areas and are not denied the opportunity to breed by any geographic barrier.

thermocline – usually defined as the region in a lake where the water temperature changes at a rate of more than 1°C per metre depth.

tributary – refers to any stream that flows into another, larger stream above its confluence with salt water (river mouth).